The Welding Engineer

Reg. U. S. Pat. Office

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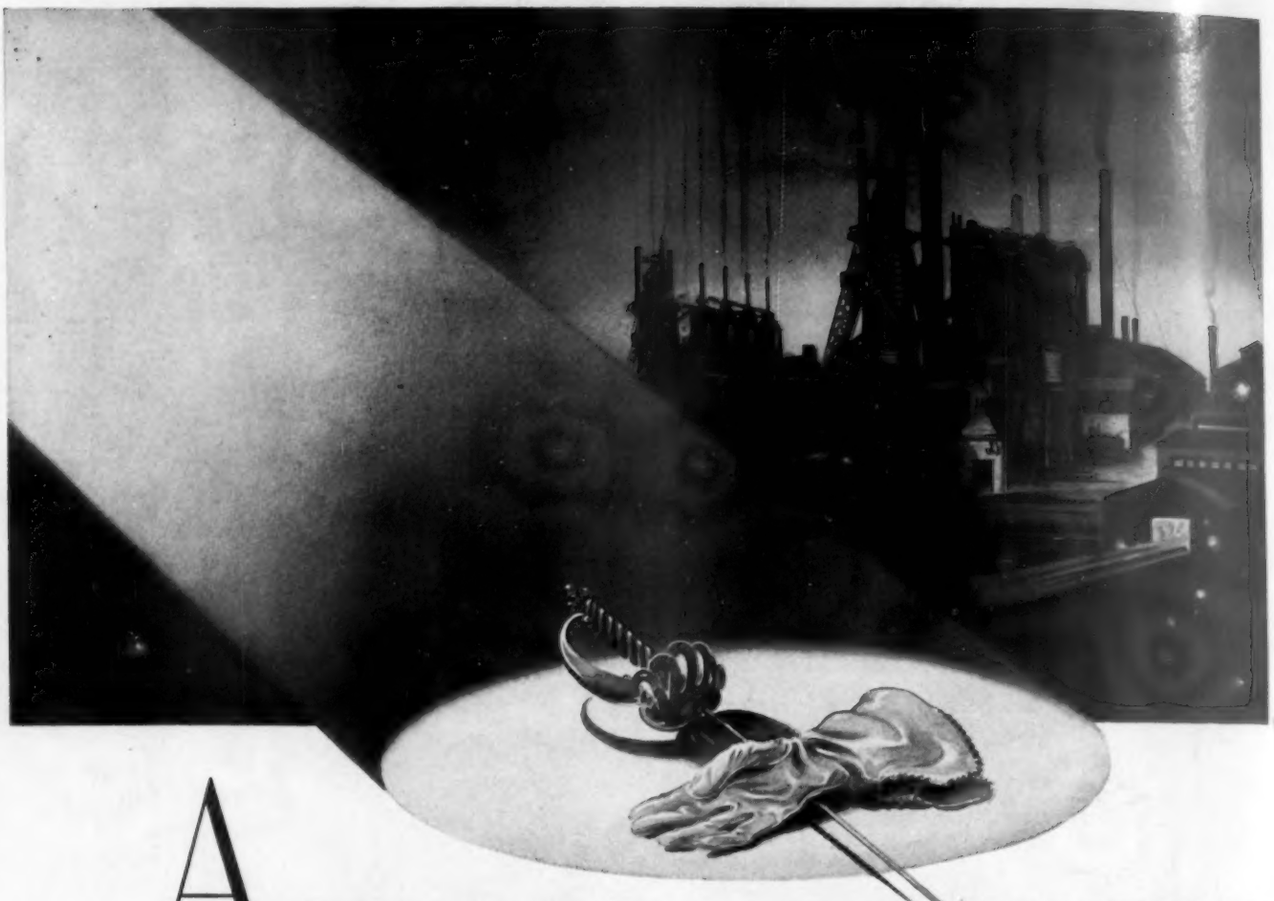

A GREATER REPUBLIC STEEL CORPORATION

accepts the challenge of industry . . .

With assets increased by more than $40,000,000, with greatly enlarged reserves of northern iron ores, with advantageous terminal facilities on the Great Lakes and strategically located additional plants, a greater Republic Steel Corporation accepts the challenge of every steel-using industry.

The merger of Corrigan-McKinney Steel Company and Newton Steel Company with Republic Steel Corporation is one of far-reaching significance. Corrigan-McKinney Steel Company brings to Republic tremendously increased facilities for the production of high grade pig iron and steel. Newton Steel Company has long been an important source of supply for quality sheets.

Even before the acquisition of these companies, Republic was the world's largest producer of alloy steels, including the famous Agathon line, ENDURO perfected stainless steels and the new Republic Double Strength high tensile steels that are lightening the weight of nearly every type of transportation unit. Republic has been the sole maker of rust-resisting Toncan Iron for more than 27 years—the pioneer in the development of electric resistance welded pipe—the maker of Sil-con low-loss electrical sheets and coiled strip.

In addition to making these trade-marked products, Republic continues to occupy an important place among the producers of high quality plain carbon steels in practically all commercial shapes.

A greater Republic Steel Corporation accepts the challenge of industry—looks optimistically to the future—keeps pace with the increasing demand for ever better steels—steels lighter in weight—steels of greater strength—steels more resistant to corrosion and high temperatures—steels that strike a new note in beauty—steels more dependable, longer lasting and more economical.

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AND SPECIAL FINISH SHEETS
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NUTS, BOLTS, RIVETS, ETC.
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THE WELDING ENGINEER

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REPRESENTATIVES

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EDITORIAL

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Getting Full Worth From the Good Workman

● The value of a good workman can't be measured by his pay envelop. Many employers don't know how to pick good workmen. Those who do get good men—good welders, for instance—often fail to get the most value from them. It is possible for any employer to get full value out of a good welder, but few superiors have the understanding to do it.

There is the story of Gideon, of Old Testament fame, who was a man-picker par-excellence. His assignment was to scatter the great hosts of Midianites. Starting with a large volunteer army, he kept thinning out the ranks. Finally he took the few thousands remaining and gave them the crucial test by marching them through a stream. Some of his panting, perspiring men stooped down in the midst of the stream and drank. These he sent back to their tents. Some—only a few hundred—did not stop in the stream, but continued the march with their eyes ever on the alert, and drank from their hands by scooping up water as they waded through. With these few men, he won a major battle.

Gideon knew how to choose his men of the ranks, and he knew how to use them afterwards.

Very few hirers of labor are blessed with the insight of a Gideon when it comes to selecting personnel. And fewer seem to know how best to use their men after selecting them.

Good welding operators are not plentiful. The plant that can boast of good men is more fortunate than perhaps the owner realizes. But the good operator is apt to be indifferent if there is not harmony between him and his superiors. When he takes an indifferent attitude, he does not do so from choice but because he feels, rightly or wrongly, that it has been forced upon him. Then he bides his time, waiting for a chance to accept employment elsewhere under more favorable conditions.

Every employer should take his welding operators into his confidence in matters affecting their work. Many a good operator has submitted relentingly to wasteful and hazardous shop practices when he found that his advice and protests were not getting past first base. Many a valuable suggestion has been smothered by a jealous superior before it got its first breath.

The well-trained operator isn't satisfied just to weld. His pride compels him to do better than meet minimum requirements. His training and experience have developed in him a keenness of comprehension about certain aspects of welding and other shop practices that make him a valuable critic of production and reclamation methods, both in the factory and the field. Having earned his spurs fairly, he likewise expects those in high places to show merit becoming their positions.

The wisest employer is the one who picks good workmen and then, by a sympathetic understanding, gets the most out of them. That is the way he defeats the Midianite hosts of unrest and agitation that are evident on every hand.

HOLD THAT ARC!

with

P&H HANSEN'S

UNIFORM CURRENT

Current fluctuations in your arc welding generator cause "sticky" electrodes, heat variations, irregular penetration and uneven strength. These characteristics are not found in P&H-Hansen welders.

The reason is that the uniform current characteristics are "inbuilt" with P&H-Hansen's exclusive internal stabilizer winding. External reactors, resistors and stabilizers aren't needed. There's one simple way to prove to yourself just how welding arcs behave. Look at the oscillograph records. Compare them! See how the irregular, jagged line smooths out when a P&H-Hansen takes hold. Then see what this means in faster, easier and better welding.

Ask us to send you a copy of Bulletin HW-3.

HARNISCHFEGER CORPORATION
4513 W. NATIONAL AVE., MILWAUKEE, WIS.

P&H HANSEN ARC WELDERS

Reducing Costs in the Weldery

Some idea of the growth of welding is seen in the estimate that there are at present approximately 45,000 welding units in the United States. About 25,000 of these have been sold in the last five years.

It isn't surprising, therefore, that an industry which is comparatively new, should still have many problems to work out before wasteful practices are eliminated and production costs reduced to a minimum.

Importance of Modern Handling Methods

Obviously as time goes on, more and more refinements will be made in welding equipment. But progress in that line will be comparatively slow as compared to the next step that welderies must take to give them immediate cost reductions. This will come through more efficient handling of materials.

In practically every type of business, handling began with a man with a wheelbarrow and developed into the use of cranes, electric hoists, monorail systems, conveyor systems, etc. They are already used to a certain extent in modern welderies but not as rapidly as the changes in welding practices warrant.

Keeping Up with the Coated Rod

Up until two years ago, industry at large used a welding rod with which it was possible to weld in any position. Then came the coated rod to form a gas envelope around the arc and make possible greater heat and a more rapid depositing of weld metal.

Because of these extremely high temperatures, weld metal becomes almost as fluid as water. To keep it from running off the work, welding should be done in a downward position. Cost figures show that welding in a sidewise or overhead position with the coated rod slows up the deposition rate so materially as to make this practice too costly for manufacturing purposes.

Hence the increasing use of specialized handling fixtures in welderies. In this branch of equipment design, the Harnischfeger Corporation has consistently led the way with various types of fixtures which reduce time in the positioning of work and give the operator a higher percentage of time for actual depositing of metal. When one remembers that in many shops, welding operators are still spending as high as 80% of their time struggling manually or with clumsy apparatus getting pieces into welding position, a better idea is gained of the cost reductions made possible with these modern fixtures.

New Fixtures for Circular Welds

For example, the problem of handling circular pieces, so long a bugbear in fast handling, has recently been solved by Harnischfeger with an inclined turntable operated by an electrical rotating mechanism. To enable the operator to weld continuously in a downward position, this table is equipped with gear shift and variable speed motor control. The operator can thus hold the rod in a steady position while the work passes beneath it at any desired speed. Speeds can be accurately regulated from 3 to 18 inches per minute in either direction at the edge of the 42-in. table. Also, the turntable can be tilted from one side to the other or held in a horizontal position to handle practically any problem in circular welding. Actual service tests show that this particular fixture can reduce welding time as much as 60%.

Special bulletins on welding fixtures may be obtained upon application to the Harnischfeger Corporation at Milwaukee.

REVOLUTIONARY!

the

P&H HANSEN

50-AMP. WELDER

Furniture, aeroplanes, toys, auto bodies, small tubing, light gauge metal containers — both ferrous and non-ferrous—these are a few of the new applications the P&H-Hansen 50-Amp. welder is finding.

Many jobs, recently considered impossible because pre-heating was not permissible, are now being done with this advanced machine. Warping and discoloration are now things of the past where the P & H-Hansen 50-Amp. welder is used.

It gives you wide welding range for handling metals 26 gauge and up. It covers a field of applications never before penetrated by the average type arc welder.

Investigate this new field and this new welder for greater profit. Ask for full information.

HARNISCHFEGER CORPORATION
4513 W. NATIONAL AVE., MILWAUKEE, WIS.

P&H HANSEN ARC WELDERS

The Welding Engineer

VOLUME 20 NOVEMBER, 1935 NUMBER 11

Permanent Repair in Crude-Oil Pipe Line

■ By ELTON STERRETT

WHEN an 8-in. high-carbon steel pipe carrying East Texas crude oil under an initial or station pressure of 900 lb. per sq. in. burst near the bottom of a long upgrade, the field through which the pipeline ran was flooded with more than 1500 barrels of oil, and any attempt at on-the-spot welding of the break was out of the question.

Sleeve With Rubber Packing Effects a Temporary Repair

Demand for oil delivery was so pressing that time could not be allowed for draining off the oil and covering the site with fresh earth as a precaution before welding in a section to replace the one ruptured. As a means of temporary repair, a sleeve was slipped over the break and clamped in place, rubber packing rings being employed to seal off its ends, thus allowing the pressure to be put back on the line at the earliest possible moment.

Sleeve Covering Break in Line.
(One end of upper half of repair "cuff" can be seen in the foreground.)

Since the day the break was covered in, the superintendent kept the spot ever in his mind, hoping that an occasion would arise which would require drainage of the line from the high point back through the station and thus enable him to replace the sleeve with a permanent repair. Over four years of continuous pipeline operation elapsed, however, without the looked-for chance; and when examination of the sleeve showed that the rubber in the joints was gradually being extruded or forced out between the sleeve clamps and the pipe wall, in ragged strings, which forecast an early failure, some prompt remedy was imperative.

Permanent Repair Made Without Draining Pipe of Oil

As there occurred no opportunity for a shutdown of duration long enough to permit drainage of the oil—or the alternative of pumping into the main line a blank of water long enough to protect the break when opened for welding—a unique "cuff" was designed to cover the sleeve completely and enable the repair to be made without shutting down the pumps, or draining off a single barrel of oil, or even reducing the line pressure.

A spare joint of 8-in. pipe was used as a mandrel. A sleeve, similar to the one used in making the emergency repair, was clamped on, and a short piece of 14-in. pipe was slipped over the sleeve, blocked in place, and wedges cut from the ends so they could be formed down as swages to contact the 8-in. pipe. This work was done by the pipeline welder, with one helper, using his standard oxyacetylene kit. After the ends were formed, the completed shell was split longitudinally into upper and lower sections with the cutting torch, and two 4-in. collars welded into the upper section at the points where the flanges of the sleeve would be, these to serve as risers.

Forming the "Cuff" on Mandrel in Pipeline Yard Reduces to Minimum Work in the Field.

Running Second Bead After "Cuff" Has Been Clamped in Place and Arc-Welded to Main Line.

Hauled to the pit in which lay the

Sealing Off the Job After Grout Has Filled Space Between "Cuff" and Sleeve.

pipe carrying the emergency sleeve, the two halves of the "cuff" were clamped around the main line, which was carrying at the time 800 barrels per hour at an initial pressure of 800 lb. per sq. in., and there they were joined together again and the swaged ends welded to the main line. For this work a portable arc-welding generating set was used, with 1/8-in. shielded-arc rod. All seams were welded with two beads, a caulking-hammer test of the joint being made between beads, and in this way sufficient metal was built up to insure ample strength against the pressures to be withstood, and to safeguard against weakening under corrosion in the soil.

Grout Holds Original Repair Sleeve in Place

The purpose of the two 4-in. risers welded into the upper half of the shell was to permit of filling the space between the sleeve and the "cuff" with grout, thus holding the original repair sleeve firmly in a matrix. This prevents the sleeve from working loose after the rubber of the gaskets has finally disintegrated under the effect of the crude oil, and also prevents the sleeve clamps from pounding on the pipe, under the influence of the impulses set up by vibration in the line from the plungers of the pumps in the main-line station less than four miles away, thus eliminating any possible crystallization that might be produced at these points and might possibly bring about another break.

After the grouting was completed, bull plugs were screwed into the two risers, and a double bead run by the welder around the joint between the plug and the collar, to seal the enclosure at every point against the possibility of leak, as well as to protect against the entry of corrosion along the exposed threads.

Repair Was Speedy and Eliminated Fire Risk

Arc welding the "cuff" to the pipeline permitted the safeguarding of the sleeve to be made without shutdown, while forming of the necessary parts in the pipeline yard enabled all the preliminary work to be done in what would otherwise have been spare time, without involving extra labor cost. The entire job of welding the "cuff" in place and grouting it there required less than two hours, no oil was lost, and there was no fire or explosion risk.

So successful was this first sealing off of a main-line sleeve that a number of stock "cuffs" have been laid out and are kept on hand for other similar needs that might arise.

Purdue Announces Program of Welding Conference

The program of the 11th annual conference on welding to be promoted by Purdue University, Lafayette, Ind., on Dec. 5th and 6th, has been announced as follows:

December 5th

FORENOON

9:00 a. m. Registration, Michael Golden Shops. Exhibits, Corridor, Michael Golden Shops.
10:00 a. m. Announcements.
10:30 a. m. New Equipment and New Processes in the Welding Field. Brief statements by companies represented by exhibits and demonstrations.
11:30 a. m. Exhibits and demonstrations.

AFTERNOON

1:15 p. m. Exhibits and demonstrations.
2:00 p. m. "Resistance Welding," by L. H. Frost, welding engineer, Electric Controller & Manufacturing Co., Cleveland, Ohio.
"Types of Controls Used in Resistance Welding," by F. H. Roby, engineer, Square D Co., Milwaukee, Wis.
"Shop Costs in Job Welding," by L. C. Monroe, advertising manager, The Welding Engineer, Chicago, Ill.
4:00 p. m. Exhibits and demonstrations.

EVENING

7:00 p. m. Action of A.C. and D.C. Arc: Slow-Motion Movie Showing Comparison of Magnetic Flow Effect, by W. M. B. Brady, arc-welding specialist, General Electric Co., Chicago, Ill.
8:00 p. m. Application of the Metal Spray (talk and demonstration), by K. D. Falk, regional manager, Metalspray Co., Inc., Chicago, Ill.

December 6th

FORENOON

8:00 a. m. Exhibits and demonstrations.
9:00 a. m. "The Allocation of Various Welding Rods to Types of Work," by Jules Muller, consulting engineer, Chicago Steel & Wire Co., Chicago, Ill.
"Increasing Business with New Lines and New Work," by W. J. Volpert, state secretary, Indiana Ironsmiths and Welders, Peru, Ind.
"Procedure for Manganese-Steel Welding," by E. L. Quinn, welding engineer, American Manganese Steel Co., Chicago, Heights, Ill.
11:00 a. m. Exhibits and demonstrations.

AFTERNOON

1:15 p. m. Exhibits and demonstrations.
2:00 p. m. "The High-Voltage Welding of Copper," by W. C. Swift, service engineer, The American Brass Co., West Alexandria, Ohio.
"The Welding of Stainless and High-Tensile Low-Alloy Steels," by T. R. Lichtenwalter, metallurgical department, Republic Steel Corp., Massillon, Ohio.

Philadelphia Section Offers Evening Lecture Course

Lecturers have been announced for the evening lecture course on welding, being given through the winter months by the Philadelphia Section of the American Welding Society. The course outline is as follows:

Nov. 6th, "Qualifying and Check Testing of Welders," by Harry W. Pierce, welding supervisor, New York Shipbuilding Corp. Dec. 4th, "Selection and Inspection of the Materials," by T. Holland Nelson, consulting engineer. Dec. 11th, "Design, Layout and Preparation for Welding," by Gilbert D. Fish, consulting engineer. Jan. 8th, "Organization and Welding Technique," by Everett Chapman, vice-president in charge of engineering, Lukenweld, Inc. Feb. 5th, "Inspection and Tests of the Finished Product," by Norman L. Mochel, metallurgical engineer, Westinghouse Electric & Manufacturing Co.

"Five Steps to Good Welding" is the title given the course. All lectures will be held at 8 p. m. at the Engineers Club, 1317 Spruce St.

At the meeting of the Philadelphia Section held on Oct. 21st, J. T. Phillips, superintendent of the boiler shop, Foster-Wheeler Corp., Carteret, N. J., gave a talk on "A.C. Arc Welding." At the meeting on Nov. 18th, a paper on "Welding of Alloy Steels" was read by V. W. Whitmer, metallurgist, Republic Steel Corp., Massillon, Ohio.

I. A. A. Elects Epperson as President

C. O. Epperson, who was elected president of the International Acetylene Association at the recent convention held in Cleveland, is vice-president of National Cylinder Gas Co., Chicago, and its

C. O. Epperson, I. A. A. President.

subsidiaries. He entered the oxyacetylene industry in 1914, at which time he was practicing law in Denver, Colo. Later he became successively secretary and assistant treasurer, vice-president and general manager, and president of the Purox group of companies until

1929. After a brief interlude in the field of investment banking, he reentered the compressed-gas business with his present affiliations. He was a director and officer of the old Gas Products Association, and served as its president in 1928-29.

Born in Illinois, Mr. Epperson spent his early years at Galesburg. He attended Knox College and the University of Colorado. He received his Bachelor of Laws degree from the University of Denver in 1907. He is a member of Rotary and other clubs, and lives with his wife and three daughters at Wilmette, Ill.

Starts Commercial Weldery in Cleveland

The Lakeside Welding Co., Cleveland, Ohio, has been organized by John G. Lincoln and Homer Meanor to conduct a commercial weldery. Both Lincoln and Meanor have had a broad background of experience in welding and redesign work. Mr. Lincoln, who is the son of John C. Lincoln, chairman of the board of The Lincoln Electric Co., spent a number of years in research and development work. Homer Meanor was also with The Lincoln Electric Co., where he developed designs for welding, in the engineering department, and just prior to the formation of the new Lakeside company he was connected with the Contract Welding Co. of Cleveland.

With its own stress-relieving equipment, the new Lakeside shop, located at 3005 East 55th St., will handle commercial welding work of all kinds, including machine parts and bases, as well as contract welding in the tank-building, railroad and bridge fields.

Welded Construction Wins Out on Dump-Scow Bids

Approximately 600 tons of steel will be required in the construction of four welded dump scows which the Ingalls Iron Works of Birmingham, Ala., are building for use of United States Army engineers in the Pittsburgh harbor. The contract was awarded by Major W. D. Styer, district army engineer in charge of the Pittsburgh office, on a bid of $75,800.

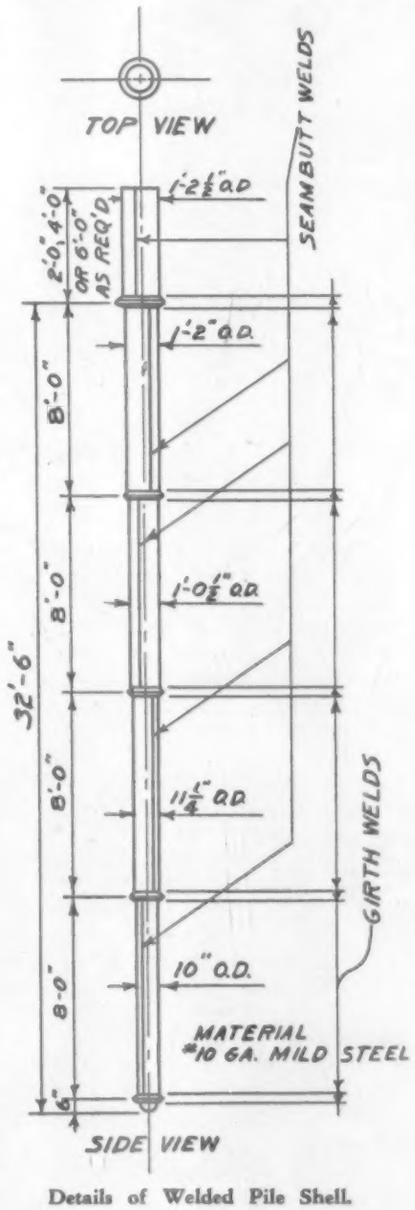
The army offices took bids on both riveted and welded construction, although the successful bidder figured only on welded construction, for which there is a growing demand. The scows, which are to be 100 ft. long, 26 ft. wide and 6.6 ft. deep, must be delivered within 210 days to the United States Depot, Lock 2, Neville Island.

Other bids received were as follows: McClintic-Marshall Corp., riveted $89,664, welded $93,320; Dravo Contracting Co., riveted $89,400, welded $87,160; American Bridge Co., riveted only, $110,488; Charles Hegewald, Jeffersonville, Ind., riveted only, $104,396; Treadwell Construction Co., riveted only, $91,600; and the Alabama Dry Docks, welded only, $83,620.

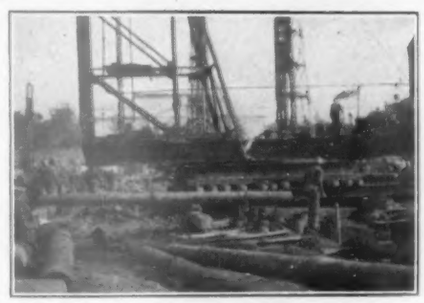
Concrete Piles Employ All-Welded Shells

Rapid progress is being made in the driving and filling of 9879 welded-shell concrete piles for the new Department of Interior Building in Washington, D. C. These piles average 35 ft. in length, and total 345,765 lineal feet. The shells are being driven by seven pile-driving rigs with 80-ft. stationary leads, powered by 40 hp. 2-drum steam hoisting engines. Each rig works six shifts of six hours each a day. Hammers weighing 7,500 lb. are used, and these fall 3½ ft. per blow, averaging 50 blows per minute.

The shells are made of 10-gauge mild steel, formed as shown in the drawing, with all seams welded by resistance methods. Each shell has 15 welded joints, totaling approximately 68 ft. 4 in. of welds, or a grand total of 675,000 lineal feet. The girth seams are lapped, while the longitudinal seams are butted and welded by the flash process.



Details of Welded Pile Shell.



Views of Welded Shells.
(In the lower view, the shell nearest the pile driver is ready to be raised into the leads.)

The blows of the hammer fall on the upper end of a 3,500-lb. nickel-steel core, which is inserted into the pile shell and which drives the point, or rounded end, of the shell through the soil to bed-rock. The number of blows required to drive each shell varies from 400 to 2,850. Naturally, the impact stresses to which the welds are subjected are enormous.

A few of the first shells driven leaked at the girth seams because of fractured welds. The resistance-welding equipment was readjusted, and no more leaks developed. After being driven, each shell is filled to the proper cut-off elevation with 1-2-4-mix concrete.

Many joints for the mechanical systems of this building also will be welded.

Completion of the finished structure is scheduled for December, 1936, which will be a record for the construction of a $10,000,000 building. All piles are being driven before Jan. 1st next.

Flame Cutting . . .

and Its Applications

■ By ARLAND USSHER
President, South Africa Institute of Welding

ACCORDING to British Standard Specification No. 499, gas cutting is defined as a process of severing metal by means of the chemical action of oxygen on metal at a high temperature. The use of the word "metal" is rather misleading, as strictly speaking oxygen-gas cutting is limited to steel and wrought iron. If cast iron and non-ferrous metals are severed with the aid of an oxygen torch, the process would be in the nature of melting rather than cutting.

Gas Cutting as a Commercial Process Dates Back to 1901

Gas cutting is generally regarded as the most up-to-date method of cutting steel. Though the process was discovered as long ago as 1887, the first torch for combining the heating operation with the oxygen jet was introduced in 1901. Machine gas cutting was actually demonstrated in Europe as long ago as 1906.

Thomas Fletcher demonstrated plate cutting in 1887, and the publicity he attracted caused a leading safe manufacturer to protest vigorously, stating, "This process can only be used for feloneous purposes and has to be suppressed."

In 1901, when the first real cutting torch appeared, it seemed that this gloomy prediction had come true, for its first practical users were safe breakers who operated successfully in a London Post Office. They were followed by bank robbers in Germany and by many others of the same profession. Naturally, public interest was aroused by these highly remunerative jobs, and it was soon realized that cutting by gas must be a quick and efficient process. Since then its development along legitimate lines has been astounding.

Process Depends on Reaction of Hot Steel With Oxygen

In dealing with the theory of the process, it is usual to recall the laboratory experiments in which a piece of steel wire is heated in a Bunsen flame, and then placed in a stream of oxygen: the wire is rapidly oxidized and disappears in a shower of sparks. Actually a chemical reaction has taken place between the steel and the oxygen, the sparks being red-hot oxide of iron.

The cutting process, which is frequently called "burning" is really just that—the burning of iron, carbon and other elements in the steel. In order that this burning may occur it is necessary to raise the temperature of the steel to red heat, and this is usually done by the preheating flame of the torch. When the proper temperature is reached, the cutting jet of oxygen is turned on and the burning begins.

It is evident that the preheating flame does not heat a piece 6 in. thick red hot all through, but if the action is watched it will be seen that the hot slag trickles down over the face of the metal and brings a thin film up to the temperature at which oxygen can burn it.

The preheating flame simply heats the top surface to a point which permits it to burn and form melted oxide, which in turn raises the rest of the metal below the torch tip to the necessary temperature.

Over 1 Cu. Ft. of Oxygen Required to Burn 1 Cu. In. of Iron

It is interesting to deal for a moment with some well established figures: Theoretically, 1.275 cu. ft. of 100%-pure oxygen is required for the complete combustion of 1 cu. in. of pure iron, the combustion producing magnetic oxide of iron (Fe_3O_4).

For instance, a kerf 5/32 in. wide, 6 in. thick and 27 ft. (324 in.) long would mean burning out a volume of 304 cu. in. of iron, and the theoretical consumption of oxygen would be $304 \times 1.275 = 385$ cu. ft., at 100% efficiency. Bainbridge cites experiments to show that it is possible to get very near the figure of 1.275 cu. ft. of oxygen per cubic inch of iron, and he accounts for practical results being slightly in excess of this figure by the fact that a certain amount of excess oxygen pressure is required in order to blow the oxides out freely from the bottom of the cut.

On the other hand, Dr. Krebs, an American investigator, states that in practical machine cutting better results than the theoretical 100% efficiency can be obtained, and he cites a cut of the dimensions given in the example above which was made by the U. S. Bureau of Standards with 342 cu. ft. of oxygen, from which must be deducted 16 cu. ft. of oxygen used in the preheating flame, so that the cut was actually made with only 326 cu. ft. of oxygen against 385 cu. ft. needed theoretically. Paradoxical though this is, the reason is simple, as in actual cutting the iron is not all completely burnt. Quite a lot of it is only loosened, and blown out.

Preheating the Oxygen Makes for Economy in Gas Consumption

Experiments carried out to discover the best mixture of the burning elements for most economical cutting, showed that it was desirable to decrease the quantity of oxygen used without affecting its velocity, as a definite velocity is required to penetrate the different thicknesses, and also to blow out the oxide. The economy can be achieved by preheating the oxygen of the cutting jet or by expanding the gas in specially designed low-density nozzles.

Preheating the cutting oxygen also has the advantage of preventing undue cooling of the kerf.

The actual cutting process is really two distinct operations; the first is the preheating of the steel, and the second is the application of the jet of oxygen to the heated metal in order to burn it.

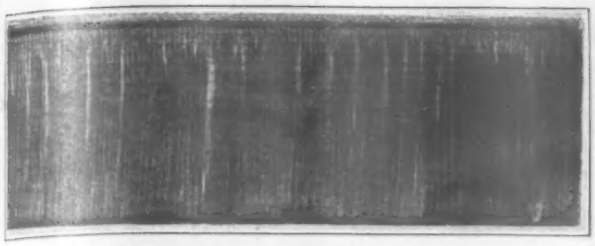
The heating flame takes no active part in the cutting operation beyond heating a small area of metal in front of the cutting jet. The heat provided by this flame is small compared with the heat generated by the combustion of the iron, but it is necessary in order to make up for heat lost by conduction and radiation and to keep the oxides fluid.

On a 6-in. cut it has been calculated that the combustion of the iron in the kerf produces ten times as much heat as the preheating flame.

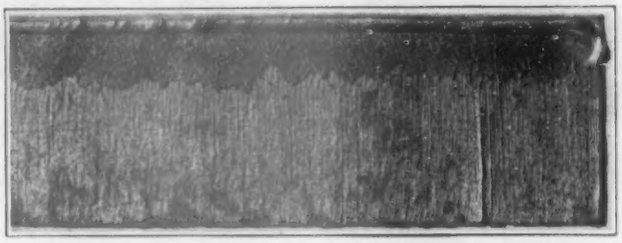
Acetylene Performs Better Than Coal-Gas

This heating flame usually consists of a mixture of oxygen and acetylene, although other fuel gases can be used. Acetylene gives a hotter flame than any other fuel gas; and we find that the time for preheating is lower, the speed of cutting is faster, and the existence of scale or rust on the material is not so likely to interrupt the cut as when, say, coal gas is used. It is also our experience that the consumption of oxygen is lower with acetylene than with the other gases.

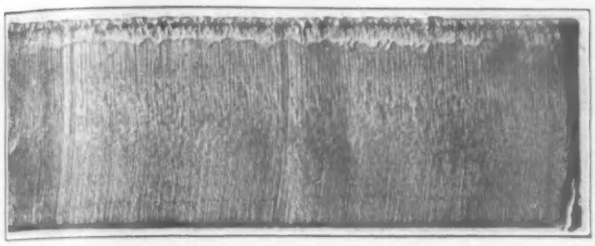
The actual cutting torch is similar to a welding torch insofar as it has a mixing chamber where the oxygen and fuel



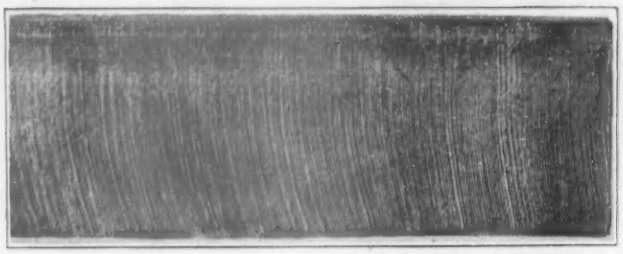
Good Cut Made Under Ideal Conditions.



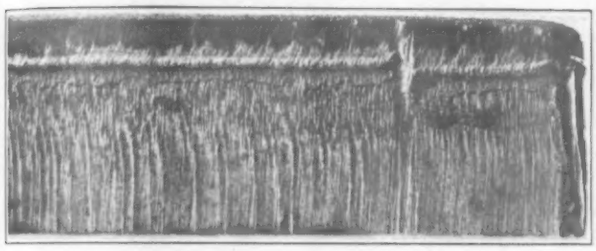
Heating Flame Too Intense.



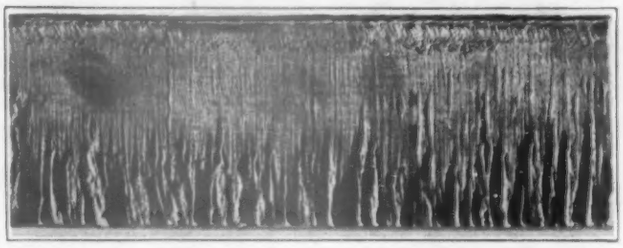
Nozzle Too Far Away From the Work.



Speed of Torch Too Fast.



Effect of a Dirty Nozzle.



Speed of Torch Too Slow.

EXAMPLES OF KERFS MADE UNDER BOTH FAVORABLE AND UNFAVORABLE CONDITIONS.

gas for the preheating flame are combined in the correct proportions. The gases are usually led to an annular orifice in the nozzle, where the flame is formed. The oxygen for cutting is conducted through a suitable valve to a circular hole centrally situated in the nozzle.

In some torches the cutting oxygen is taken from the same source as the heating oxygen. In others, an entirely separate supply of oxygen for cutting is used, which type requires three hoses.

It will be noticed that the jet of cutting oxygen is surrounded by the preheating flame, so that the torch can cut in any direction, and this arrangement has the advantage of heating the oxygen jet to a certain extent before it impinges on the metal to be cut.

Condition of Nozzle Is Very Important

The actual process of cutting looks very simple, but several precautions have to be taken to ensure perfect cuts. For instance, the nozzles must be perfectly concentric and clean or the flame will be deflected from its correct position, and the cut spoiled.

The preheating flame must not be too intense, or the top edge of the plate will be melted, and distortion troubles will occur with thin plates. If it is not hot enough, the speed of cutting will be slow, and the cut may even stop altogether. The gas pressure must be sufficient to cut right through the material; but if excessive, the bottom of the cut will be wider than the top.

Smooth Cuts Require Uniform Speeds

For smooth cuts the movement of the torch must be at a uniform speed. If it is too fast, the cut will be rough and the top and bottom edges will not register, due to what is termed the drag of the cut, and also the cut may stop altogether if the torch is moved so fast that the preheating flame cannot heat the new metal rapidly enough to maintain combustion of the iron. If the torch should stop advancing, the cutting oxygen immediately strays from its course, and attacks the surrounding metal, which, of course, ruins the appearance of the cut face.

Any vibration of the torch will be reflected in a corresponding roughness of the cut. Cutting by hand can be fairly smooth if the operator is an expert, but the result usually is very rough.

When the cutting torch is advancing at the correct speed, the stream of sparks will be at right angles to the surface of the material being cut—that is, usually straight down. If, however, the torch is going too fast, the stream of sparks will trail behind, and, conversely, it will appear to go ahead of the cut if the speed is too slow.

The maximum cutting speed for any thickness depends on the rate at which the small area of metal immediately in front of the cutting jet can be heated.

Where a perfectly smooth cut is not required, a fairly fast speed can be obtained, but it is advisable to use a slower speed on work that is to have a good finish.

For profile or shape cutting, it is necessary to get straight-down cutting or the top and bottom edges of the cut will not register. This means that the speed must be so adjusted that there is no drag on the cut. Straight and large circular cuts can be made at a much greater speed, as the drag is then unimportant.

Cutting Speeds Vary With Thickness of Work

The speed of cutting depends to some extent on the finish required. The faster the cut, the rougher the finish. For cutting cold steel the following speeds in feet per hour are obtainable with oxy-acetylene:

Thickness of plate, in.	¼	⅜	1	1¼	2	3	4	6	12
Normal speed, ft. per hour	70	60	46	40	35	26	23	21	16
Fast speed, ft. per hour	100	90	65	55	50	40	35	25	—

The usual speeds given in tables apply to cold metal, but they can be increased by 50% to 100%, according to thickness, if the metal is hot, say about 700°F. It is a great economy to cut forgings while they are still hot.

Steels having 0.3% carbon and over are usually cut up to 40% or 50% faster than mild steels, while to obtain a smooth cut on manganese steel it is necessary to almost double the normal speed.

Whenever possible the cut is started on an edge of the material, but if an inside cut is required it is necessary to drill a hole through the metal to enable the flame to get a start. The size of the hole is immaterial, as anything from ⅛ in. upwards is suitable.

When Piercing Holes, Take Care Not to Foul Nozzle

Holes in solid plate up to 2 or 3 in. thick can be pierced with a cutting torch, but it is not advisable to use the torch of a cutting machine to pierce holes in plate over ½ in. thick owing to the possibility of metal squirting up and fouling the nozzle. In piercing holes, it is a good plan to shut off the fuel gas just before turning on the cutting oxygen, as this enables the hole to be blown through the plate without much splashing.

When machine cutting thick material it is important that the starting edge be strictly perpendicular or actually overhanging slightly. If any part of the starting face projects beyond the top edge it will be very difficult to start a cut, as the cutting jet will not readily attack the material at the bottom and the resultant cut, if any, will be very poor.

It is important that the place where the cut is to start be properly cleaned. If the face is flat, a wire brush will be effective; but if it is slightly rounded, as often occurs with forgings, a saw cut should be made in order to obtain a clean, straight face or groove which will tend to guide the cutting jet at the start.

Method of Starting Cuts on Thick Material

A machine cut on thick material is started by igniting the blowpipe and placing it over the edge of the material in such a way that two-thirds of the heating flame is playing on the top of the metal, while the remaining third goes down the face. During the preheating the torch should be moved back to the edge of the metal and then forward to its original position several times. When it is observed that the starting point is hot enough, the torch is quickly moved back until it is quite clear of the material and at the same moment the cutting oxygen is turned on and the cutter is moved up to the edge again and the cut begins. A good start cannot be made while the cutter is in the preheating position, that is, actually over the metal.

The start of a cut on material over 10 in. thick can be assisted by raising the back edge so that the starting edge overhangs the face where the cut is to begin. When the cut has penetrated through to the under side of the material, the back edge can be slowly lowered to its normal position.

Distance of Nozzle Must Be Watched Carefully

When the cut is actually progressing, attention must be paid to the distance of the nozzle from the material. It is most important that the correct distance be carefully maintained, as the quality of the cut largely depends on this point. Heavy plates may possibly be set up not dead level, and light plates distort on account of the heat generated at the cut. Hence, if the nozzle is not watched all the time, it may actually touch the material and become spoiled, or it may get too far away and spoil the cut or cause it to be stopped altogether.

It is important that once started a cut should be carried out without the cutter stopping for even a fraction of a second, as at each hesitation the oxygen attacks the metal on either side of the true cut. The cutting nozzles must be kept scrupulously clean and perfectly concentric, or cuts will be bad. Where a perfect machine cut is required it is good practice to run the preheating flame alone over the line of the proposed cut, as the heat will have the effect of loosening the scale on the plate.

To cut thick material by hand, the cut is most easily started by beginning at the bottom edge and gradually working up to the top, after which the torch can be guided across the top of the piece.

A heavy machine cut cannot be considered as having started until full straight-down penetration has been obtained; and provision must be made when designing the job to allow sufficient metal in which to get the cut started, as smooth, straight cutting cannot be expected until a considerable amount of heat has been generated right down to the bottom of the job.

Regulator Heater Prevents Freezing in Cold Weather

In cold weather and for material over 3 in. thick, it is advantageous to use a regulator heater, which prevents the regulator from freezing, warms the oxygen in passing and reduces the cooling effect of the cutting jet as it impinges on the material being cut. An increased rate of cutting and a saving in oxygen are obtained.

Tinted glasses should always be used to protect the eyes of the operator from the glare and from sparks which are liable to fly about occasionally.

When cutting a round bar (or starting on a convex surface) the surface of the bar where the cut is to be started should be nicked with a chisel so as to produce a lip which will rapidly become hot enough to start the cut.

Cutting Structural Steel Shapes

To cut channel irons by machine, they should be set up with the back uppermost and the torch nozzles chosen to cut through the thickness of the flange. The cut is then started at one flange and run right across the channel in one operation. Angles are cut in a similar manner.

To cut joist sections, the torch is set to cut a thickness about three times the thickness of the flanges. Each flange is then cut through in turn, after which the section is laid on its side and the uncut portion of the web is severed. This process means that three settings are required for cutting joists. Similarly, tees are cut in two settings.

High-Carbon Steel Should Be Preheated Before Cutting

As already mentioned, the gas-cutting process can be applied to wrought iron and mild steel without having any ill effects on the metal. High-carbon steels should be cut at a dark-red heat, in order to prevent the cut face from hardening due to the rapid cooling which would be caused by a large mass of cold metal adjacent to the white-hot face of the cut.

If high-carbon steel is cut in the cold state, all signs of hardening can be removed by annealing, but there is a possibility of fine cracks occurring when this class of steel is cut while cold.

Alloy steels containing up to 45% nickel, 13% tungsten, 10% silicon, and 4.5% chromium can be cut successfully. Stainless steels are difficult to sever because their very nature prevents them from being oxidized.

Hardening Effect Is Not Severe on Low-Carbon Steel

The general effect of gas cutting is to harden the cut face and there is an increase of carbon near the surface of the cut. When mild steel is cut, the Brinell hardness increases by 30 or 40 points, but the surface of the cut of mild steels containing up to 0.3% carbon is readily machinable. The effect of gas cutting is similar to that produced by water quenching and tempering.

When cutting mild steel up to 0.25% carbon and 3 or 4 in. thick, the maximum depth of changed structure does not extend inward from the cut face for more than ⅛ in. The thickness of the disturbed area varies with the thickness of the steel being cut, and at a thickness of 6 in. it may be ¼ in.

If the steel is normalized after being cut, all traces of the cutting effect will be removed, but articles cut from steels

containing up to 0.3% carbon can be used exactly as they leave the cutting machine.

E. J. Clarke records some experimental results that are of considerable interest.

First of all, specimens were made of unwelded flat pieces cut from 3-in. steel billets in such a manner that the largest possible cut surface could be subjected to strain.

Each of three solid metal test pieces was cut by a different method—namely, oxyacetylene, oxy-coal gas and a machine saw, and the results are as follows:

Method of Preparation	Oxy-Acetylene Cut	Oxy-Coal-Gas Cut	Machine-Saw Cut
Maximum stress, long tons per sq. in.	27.56	27.4	26.2
Yield stress, long tons per sq. in.	16.1	16.5	15.0
Elongation on 2 in., per cent	30	33.5	26
Elongation on 4 in., per cent	21	21.75	19.2
Elongation on 8 in., per cent	17	17.5	13.5

It will be seen that superior results were obtained with both gas-cut specimens, maximum stress, yield point and elongation being higher in each case than in the saw-cut piece. Under microscopic examination it was found that the disturbed area extended to a depth of only 0.05 in. The surface structure was finer than the body, in the case of the gas-cut specimens, and no doubt this finer surface structure is partly responsible for the better mechanical test results; the outer layer of steel, having what is virtually a normalized structure, would be tougher than steel having a larger grain.

Having investigated the effect of these methods of cutting on steel, Mr. Clarke proceeded to investigate the effect of welding similar steel plates cut in the same manner, using flux-coated electrodes designed for ordinary construction work. The following conclusions were reached:

Good Welds Obtained Without Removing Oxide Film

Welds made on gas-cut specimens with gas-cut V's gave results similar to those usually obtained in practice under ordinary conditions with the electrodes used. The removal of the oxide film from the V before welding made no definite improvement on the results. There is fairly conclusive evidence that when welds are made with flux-coated electrodes of average quality, any oxide film remaining on the surface of the V has no deleterious effect upon a weld made on it if the cut has been fairly clean. The nature of the flux on heavy-coated electrodes is such that the oxide on the surfaces being welded is either reduced (in a chemical sense) or floated up to the surface of the weld, where it combines with the slag. Tests carried out with bare wire and light-coated electrodes on oxyacetylene-cut mild-steel specimens showed that the tensile and bend-test results with the light-coated electrodes were better than those with bare wire, but both results were definitely inferior to those obtained with flux-coated electrodes. It should be remembered that in ordinary welding practice, light-coated electrodes give better results than bare wire, and heavily flux-coated electrodes give results superior to light-coated rods.

The photomicrographs included in Mr. Clarke's paper illustrate clearly why inferior results are obtained. There is a good deal of fine oxide inclusions right through the welds, especially in that of the bare wire, but what is particularly noticeable in both cases is a dark band near the junction. This band is undoubtedly caused by finely divided oxide inclusions which have dispersed from the oxide film on the side of the V for a short distance into the weld metal, which will naturally make the metal in this zone particularly weak. The small amount of flux on the light-coated electrodes is effective in producing a cleaner weld than the bare wire, but it is quite evident from the results given by Clarke that when welding gas-cut plates it is essential that good-quality flux-coated electrodes be used.

In the case of oxyacetylene welding, there will be no ill effects from the oxide skin left by gas cutting, because a reducing flame used for welding will eliminate the oxide.

High Oxygen Purity Saves Gas and Time of Cutting

Tests made by the British Oxygen Co. with oxygen purities varying from 97.5% to 99.5% show that small increases in oxygen purity greatly increase the efficiency of the cutting operations, both as measured by oxygen consumption and by time required to complete a given amount of cutting. Taking 99.5% as standard purity, there is an increase in oxygen consumption of at least 12% for each ½% decrease in purity, and the actual time required to make cuts is increased by at least 13%.

The purity of the oxygen made in South Africa today is between 99.5% and 99.6% and great care is taken to keep moisture out of the gas, as an excess of water vapor can have a very bad effect on the cutting properties of the gas.

Cutting Torch Can Be Put to Special Uses

Apart from the mere severing of mild steel, there are some special uses of the cutting torch.

Rivet heads can be cut off flush with the surrounding plate by using a special tip on a standard-type cutter. The start of the cut is assisted by "nicking" the side of the rivet head with a chisel, as this provides a spot which will quickly become incandescent.

Another type of tip enables boiler tubes to be cut out.

Used for Deseaming and Flame Turning

The deseaming torch is quite a new tool, which is designed for removing large quantities of metal from the surface of steel ingots, etc. To remove a flaw in an ingot, the metal is heated and then the cutting oxygen is applied. The torch is moved very rapidly along the surface, removing the faulty steel in a surprisingly short time.

A similar torch can be used for what has been called "flame turning." This process is most useful where large quantities of metal have to be removed from a round object such as a shaft with widely different diameters. The shaft would be set up in a lathe in the usual manner, but instead of a cutting tool a special torch is mounted on the slide rest so that it can be applied to the underside of the material to be turned. The torch is ignited and when the material is sufficiently hot the cut is started and the lathe rotates the work towards the cutter. A great deal of material is removed in a very short time, and of course the power consumption is negligible. The same type of torch could be mounted in other machines for grooving, planing, etc.

One application of the cutting torch consists of the centering of large shafts prior to machining, and a similar use is the removal of rivets, including the countersunk variety, which cannot be cut out by the ordinary rivet-cutting torch. Flame drilling and flame boring are also just around the corner, if not already practicable propositions.

Cast Iron Is Readily Cut With Special Cutter

By using a special cast-iron cutter it is possible to cut all grades of cast iron up to 20 in. or more in thickness, the cut being wider and rougher than that obtained on mild steel. The cast-iron cutter is similar in construction to the mild-steel cutter, but it has especially large gas passages and a large injector, and is designed for working with an oxygen pressure of not less than 70 lb. per sq. in.

An oxyacetylene flame is required, and, as an ample supply of both gases is necessary for cutting heavy material, a battery of oxygen cylinders with a heater should be used in order to prevent the regulator from freezing. The ordinary type of portable acetylene generator cannot supply sufficient gas, and it is usual to couple two or more dissolved-acetylene cylinders together.

The essential of a cast-iron cutter is that it shall be easy to obtain a flame which has a considerable excess of acetylene, and when cutting cast iron the acetylene "cone" of the flame should be from 2 to 4 in. long.

It is not possible to oxidize cast iron in the same manner as steel, and cast-iron cutting usually amounts to heating a small area of the iron close to the melting point and then using a high-pressure jet of oxygen to blow the metal away.

As a narrow cut would soon become blocked up at the bottom with metal and slag, it is usual to combine a slight sideways motion with the forward movement of the cutter so that the cut is usually ½ to ¾ in. wide. This oscillating motion also has the advantage of continually applying the cutting oxygen to parts of the iron which are just melting under the influence of the preheating flames, whereas if it was not so moved the oxygen jet would soon cool the iron and stop the cut.

In cast-iron cutting the preheating flames have to produce about 90% of the heat required and the oxygen jet only about 10%. The process is hard on the operator on account of the tremendous heat, slow progress and the flying sparks. Nevertheless, cast-iron cutting is very useful for breaking up large machine parts such as old flywheels, in order to get them through small doorways. It is also used for removing old cast-iron pipes and columns and for demolition work generally.

Process of Cutting Steel Under Water

The process of underwater cutting was used in France and Germany before the war, and although it was then surrounded in mystery, it can today be considered as a practical industrial proposition.

In the modern underwater cutting torch, the heating flame burns in a cavity arranged in the head of the torch and the burnt gases drive back the water on which they impinge. The operator has an unobstructed view of the work he is doing.

The blowpipe can be ignited under water by a pilot flame in the head or by a special device which can emit a small quantity of a chemical powder which spontaneously ignites on coming into contact with water.

The depth at which the underwater cutting torch can safely operate depends on the pressure which can be put on the acetylene, but work has been carried out at a depth of 40 ft. There is now, however, an oxy-electric cutting process by which work can be done at any depth.

One of the first applications of gas cutting was so-called lancing. It was devised out of the necessity of opening frozen outlets of steel furnaces. The lance consists of a long steel tube connected to a bank of oxygen cylinders. The steel tube is held up against the furnace outlet and its end heated to a white heat. Then, when oxygen is blown through, the end of the tube starts to burn and the heat of this combustion ignites the steel in the furnace outlet and the oxygen then acts on both. Gradually the steel tube is pushed deeper into the frozen steel, until it is completely penetrated; at the same time the steel tube is itself partly consumed.

The oxygen lance is also used for breaking up heavy steel for scrap where ordinary cutting would not be economical. A hole is burnt with the lance just deep enough to take a charge of dynamite, which does the final breaking up. Rough cuts can also be made by working the lance up and down through the steel. Thicknesses up to 8 ft. have been cut.

Cast iron can also be drilled with the lance, as the melting steel tube combines with the cast iron and the mixture of both is easily perforated. It takes about a minute to make a 1-in.-diameter hole in 12 in. of cast iron.

New uses for gas cutting are being discovered almost every day, but only a few applications can be mentioned here.

The hand cutting torch is used extensively for cutting scrap into suitable sizes for re-melting, as well as for demolishing obsolete machinery and plant.

Bridge Replacement Change-Over Facilitated by Cutting

When old bridges are to be replaced by new ones, it is usual to build the new structure alongside the old and when a suitable time for making the change-over occurs, the gas cutter is used because it is the quickest tool for breaking up the old bridge. So rapid is the demolition process that railway bridges are often changed over between Saturday night and Sunday morning without any interruption of traffic.

After railway and mine-shaft accidents, the gas cutter is frequently used for the removal of steel obstructing the rescue operations.

In the steel foundry, risers are almost invariably removed by gas cutting.

The hand torch can be used for cutting steel plates and sections prior to machining and welding, but the finish of the cut is usually very rough. By using a special centering device it is possible to produce very clean-cut holes in plates and sections of reasonable thickness, thus eliminating drilling. For making holes in the field on steel structures there is nothing to touch the hole-piercing cutter for sheer speed and ease of operation.

The following extract from the latest British Standard Specification (No. 538) for "Metal Arc Welding" is of considerable interest. Paragraph 6b on "Flame Cutting" lays down that "Edges and ends to be welded may be cut to shape and beams and other sections cut to length with a gas cutting machine. Hand cutting may be substituted for machine cutting only with the approval of the Engineer or Purchaser."

Torch Machines Effect Very Smooth Cuts

The purpose of cutting machines is to guide the cutting torch over the work smoothly and at a suitable uniform speed. The resultant cuts look as if they had been made by a saw, and of course the speed is much greater than any other method of cutting, apart from punching and shearing, which processes are limited to comparatively thin material and in any case require considerable power to drive the machines. The motive power of a large cutting machine seldom exceeds ¼ hp.

The ability of cutting machines to produce intricate shapes from steel plates or slabs of almost any thickness has induced many overseas manufacturers to dispense with forgings, and some local firms are now limiting their forging operations to slabs only, the cutting machine being used to complete the shape.

When welding is allied with a cutting machine, the need for castings is reduced almost to the vanishing point, as in the majority of cases "weldings" can be built up to give a cheaper and stronger job than any casting. The time required to produce the finished "welding" is often less than that required to produce a pattern, and the finished job is 100% reliable, as there can be no hidden blow-holes such as would turn an expensive casting into scrap after nearly all the machining time has been spent on it.

Cutting Applied to Forgings and Other Parts

One of the frequently applied uses of gas cutting is the gapping of crank shafts, and the cutting out of complete small crankshafts. The ends of connecting rod forgings are also frequently cut out to form the jaws. In the South African Railways' workshops, gas cutting machines are extensively employed on the production of hundreds of truck and locomotive parts. One of the first production jobs for cutting machines in England was the cutting out of locomotive frames.

Since high-carbon steels are as easily cut as mild-steel, it is now common practice to use cutting machines for forming stripping dies, etc.

Manganese-steel tubemill liner bars used to present a problem to one of the local steelworks, as the only quick method of cutting-off was hot-sawing, and this meant that the bars had to be sawed immediately after rolling, as re-heating was too costly. The result was considerable delay, as these bars could be made only to order. The solution

the problem was of course a gas cutting machine. The bars are now stocked in random lengths and are very rapidly gas cut to the required lengths.

Slot links for the reversing gears on pneumatic winches used to take days to cut out on a shaping and slotting machine, but they are now turned out on a gas cutting machine so accurately that draw filing produces the required finish.

The following list will serve to indicate a few items that are regularly produced by cutting machines: Base plates, gusset plates, triangular stiffeners, gear hubs and blanks, bosses, flanges, crane hooks, lever handles, large spanners, manholes and openings in tanks and boilers, tank or boiler ends, large gears and sprockets, locomotive-firebox foundation rings, connecting rods, link-motion parts, crankshafts, profiled blanks prior to shape forging, and generally, any conceivable shape in steel plate.

A common job is the trimming of plates to size and the preparation of V edges for welding. A special double-tip cutting torch is now available for cutting two V edges at once.

Torch Spurs on Movement Toward Replacing Castings With Steel

The American machine tool industry has whole-heartedly adopted welded steel fabrication in place of castings. The first welded designs were rather crude and had too many jutting out corners, and generally looked badly proportioned, but the proper application of machine gas cutting both in the drawing office and the shop has improved the situation so much that modern fabricated machine tools, after being properly finished and painted, are almost indistinguishable from the more conventional cast frames.

The electrical industry has taken up "welding" in all its branches, from small switch tanks to giant alternators, and it must be remembered that this modern method of fabrication would be quite impossible without machine gas cutting.

The usual tolerances for gas-cut machine parts are from +0 to —1/16 in., but it is interesting to note that in one case on record several parts cut from the same template on a cutting machine did not vary more than 0.008 in.

It is not yet possible, in this country of cheap cast iron and expensive mild steel, to oust all castings; but intricate shapes, which would require days of pattern making alone, can be designed, cut and welded in less time than it takes to make the pattern. Mechanical engineers are a cautious and conservative body, but they cannot much longer shut their eyes to the fact that "weldings" are theoretically, practically and mechanically perfect and of good appearance. It is the cutting torch which has severed the shackles imposed on design and manufacturing and has permitted the engineer to follow a more theoretical line of design, which is really the basis of all sound practical engineering.

Demand Increasing for Welded River Barges

The demand for all-welded construction, especially for river floating equipment, is increasing rapidly according to S. D. Brown, sales manager for the Dravo Contracting Co., of Pittsburgh, Pa., who reports that their marine yards on Neville Island are exceptionally busy at present.

The last of five all-welded barges, for stock purposes, have just been completed and launched from the Dravo marine ways on the Ohio River, and the company is now starting the construction of four covered barges, of all-welded construction, for the transportation of package goods, such as cement. These barges will undoubtedly be disposed of before completion, according to Mr. Brown, who says there are an unusually large number of inquiries for barge equipment at present. If not, they will be added to the Dravo fleet.

The Dravo company is also building ten river barges for the Ohio River Co., five of which, having welded frame construction, have been completed. The remaining five will be delivered by next spring.

"Our yards are always busy on repair work," said Mr. Brown, "and the majority of repairs are now done through welding. From the outlook at present, I think we can expect an excellent volume of business next year."

Buried by Sand, Man Owes Rescue to Cutting Torch

An act of heroism, together with the timely use of an oxyacetylene cutting torch, saved J. C. Jordan, of Booneville, Ore., from certain suffocation recently when he fell into a gigantic hopper and was buried alive as the hopper was being filled with sand. Elmer Seigfreed, a fellow worker, burrowed his way through the sand to Jordan's face and then cupped his hands over the man's nose, making it possible for him to breathe until a welder could cut holes in the bottom of the steel hopper with a cutting torch and allow the sand to flow out, liberating the two men. The accident happened on a large dam construction job.

Get "*H. O. T.*" on Welding

■ By H. O T. RIDLON

[This section is dedicated to Better Welding and Better Welding Shops. Suggestions and criticisms are invited.]

I.A.A. Is Over— Purdue Is Coming

Just back from the International Acetylene Association Convention which was held in Cleveland this year. Truly a grand show, with many fine papers. It was great to see so many of my old friends again. But a lot of you welders are throwing away the chance of a lifetime in passing up these welding conferences, for it is there that you have the opportunity to get wised up on the new things in the industry. And here's a tip for youse guys: the big shots in the industry are just as human as you are and are more than anxious to help you by giving you the info you want which they have at their finger tips (sometimes). The next show is the Purdue Welding Conference at Lafayette, Ind., on Dec. 5th and 6th. To you who live around Indiana and Illinois, it really is worth going to if you go there with the idea in mind of learning all you can in those two days. I understand that it is to be a great show this year with lots of new things to hear about and see. I'll be seeing you there.

• • •

The Picture

See that picture on the front cover of this magazine, showing a table and lamp made from aluminum welded tea-kettle spouts? Neat job, I calls it. Orchids or something for the welder, Dan Grow by name, who haunts Chicago and those parts. Sort of looks like something that might appear in one of those swanky home magazines.

• • •

Oddities in the Industry

From good authority, I get that a certain young lady who has had many years' experience in the Industry in the Pittsburgh territory, blushed twice within a month.

Saw this sign near East Liverpool, Ohio, the other day: "Jimmies Inn 3 Miles." Well, well, well, now ain't that something. Could it be that a certain welding equipment salesman in Pittsburgh has changed his business?

• • •

The thought for the month: Common sense is not so common.

Views Showing Welding in Construction of New Highway Bridge at Franklin, Ohio.

New All-Welded Highway Bridge Built in Ohio

A new, all-arc-welded steel bridge at the south end of the town of Franklin, Ohio, has just been opened to traffic. It is a three-span bridge with steel I-beams used in the following sizes: 6, 12, 24 and 27 in., supporting a battledeck floor. The floor is composed of steel plates ½ in. thick and 4x24 ft. in size.

Two Hobart 400-ampere arc welders were used on the job by Gordon Reiss of Mt. Healthy, Ohio, and approximately 6,000 ft. of welding was involved.

The approximate speed on beam welding was 12 ft. per hour. The welding was done with a considerable amount of moving around to different parts of the bridge to avoid concentrating heat too much in one portion of the structure.

The speed on floor-plate welding was approximately 8 ft. per hour. This welding also had to be done in short stretches, which cut down the footage considerably but kept distortion at the minimum. All battledeck floor plates were cut with 60° bevel, and a ¼-in. gap left between sheets gave room for welding them to the beams. The majority of the floor-plate welding was made in three passes: the first pass with ¼-in. electroder, and the second and third passes with ⅜-in. electrodes. There were also 1800 plug welds to hold the floor plates to the beams.

Less than 800 hours was required on the entire job, including supervision, tacking, scaling, etc.

The bridge is 140 ft. in length and 40 ft. wide, accommodating four-lane traffic. There are only two other bridges of this construction in Ohio. Final inspection from the state expressed high approval in accepting the final job.

Dry Ice Removes Explosion Hazard While Welding

A welding job on a tank buried in dirt soaked with an inflammable solvent, is an exceedingly hazardous undertaking. By employing dry ice (solid CO_2) a job of this nature was recently completed successfully. The story, as told in a recent issue of the Chemical Section *News Letter*, of the National Safety Council, as follows:

A group of about 40 10x10-ft. steel tanks, used for the storage of wood alcohol and other inflammable solvents, were moved and buried with dirt and sand as a fire-prevention measure. Soon thereafter, a leak developed in old 2-in. screw plug in the center of the bottom of one of the tanks, and before it was discovered several hundred gallons of the liquid had leaked out into the freshly filled earth.

The only efficient means of stopping this leak was to weld the tank on the inside at the bottom. Therefore, the tank was pumped out and purged with caustic solution and live steam, and fresh air was blown into it. After testing for vapors with a combustible-gas indicator, two men were allowed to enter through a manhole in the top of the tank. Both wore standard safety belts and life lines. They scoured the inside of the tank and removed the last bit of scale and residue, and the fan was kept blowing continuously while they worked.

No inflammable vapors remained inside the tank, but it was feared that there might be explosive vapors in the filled dirt surrounding the tank, and these might be ignited by the welding operation, or vapors might seep back through the tank while the men were welding.

To prevent this, dry ice was packed around the leak for a depth of about 3 in. and in a circle about 12 in. in diameter. A cap of steel about 14 in. in diameter and 3 in. deep was then placed over the top of the packed ice, and the edge of this cap was then welded to the bottom of the tank with an electric arc.

The purpose of the dry ice was to render the atmosphere around the leak inert and to prevent any inflammable vapors from coming back through the hole while welding.

All the other tanks in the group were tightly sealed and no pumping either in or out of the tanks was allowed while the welding was in progress.

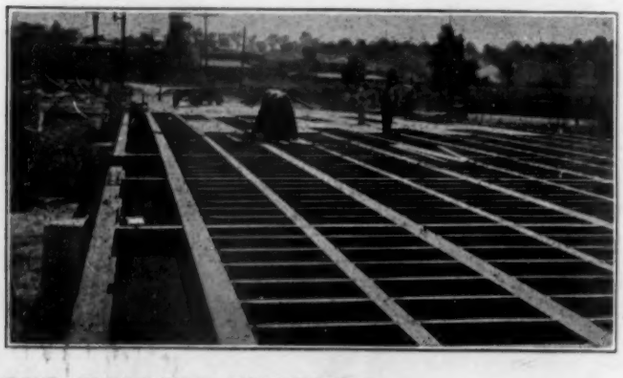
November Program of Los Angeles Section

The following features are tentatively planned for the meeting of the Los Angeles section of the American Welding Society, scheduled for Nov. 14th:

L. P. McAllister, metallurgical sales engineer, of Lukens Steel Co., Coatesville, Pa., will talk on "Specifications for Steel Plate for Welding, and the Advantages and Disadvantages of Alloy Additions."

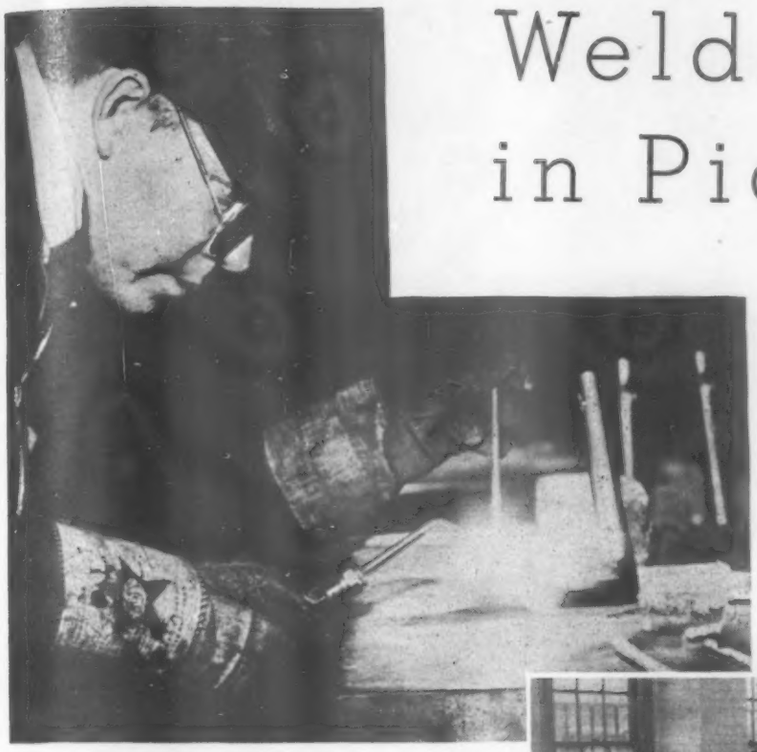
E. J. Cipperly, of the General Electric Co., and John Lucas, of the Southwest Welding & Manufacturing Co., of Alhambra, Calif., will give descriptive talks on "A New Automatic Welding Machine." New automatic shielded-arc welding equipment has recently been installed in the Alhambra plant of the Southwest Welding & Manufacturing Co., and is now in production work on large-diameter pipe. Mr. Cipperly and Mr. Lucas will describe the equipment, the plant layout, and the welds produced by the new machine.

A general discussion on "Practical Welding Problems, and How They Have Been Solved" will follow.



Welded Beams, on Which Floor Plates Are Laid and Welded.

Welding News in Pictures



• Applying hard-facing alloy to blades used for shearing red-hot glass, at the Toledo plant of the Libby Glass Mfg. Co. Hard-faced blades outlast hardened steel blades 10-to-1. (Photograph courtesy of the Haynes Stellite Co.)

• Below — Welding the roof of a 200,000-gallon bulk storage tank. Supporting trusses are also welded. (Photograph courtesy The Lincoln Electric Co.)

• View of a corner in the modern shop of the Hans Hansen Welding Co., Toledo, Ohio.

• After running 330 miles, this chain, with cross lugs faced with Stoodite, on a 40x8 truck tire, was still good for at least another hundred miles. (Photograph courtesy of The Balbach Co.)

• Prefabricated steel roof sections, placed in position and welded, shelter this all-steel welded home shown in course of construction. (Photograph courtesy of Hobart Bros.)

Qualification Tests for Pipe Welders . . .

A discussion of the American Standards Association Code, with suggestions to those directly affected by its provisions

■ By R. B. LINCOLN
Director, National Weld Testing Bureau

THE new American Tentative Standard Code for Power Piping requires the qualification of welders and gives definite instruction as to the tests required. The sponsoring body is the American Society of Mechanical Engineers and the Chapter on Welding was prepared with the cooperation of the American Welding Society. It represents one of the most authoritative statements on this subject and is expected to serve as a model in preparing legislation.

The purpose of this paper is to discuss the "pitfalls" usually encountered in "qualifying" for the first time, with suggestions as to how to avoid failure. Since the Code has been recently issued (July, 1935) it may be of value briefly to discuss its requirements. No attempt is made, however, to repeat the complete specifications contained in it. It may seem unnecessary to say that the Code should be carefully studied, but experience shows that contractors will sometimes accept jobs specifying code compliance without informing themselves on code requirements.

Code Specifies Two Classes of Tests for Welders

The tests required vary with the pressure, temperature and welding positions to be used in construction, and are shown in the Code in a convenient table. It will be noted that for pressures of 125 lb. per sq. in. or less the lower-class tests (designated as a, b, c and d) apply, but for pressures above 250 lb. the higher-class tests (e and f) are required. In the range between, that is, above 125 lb. and up to 250 lb., the higher-class tests are required for temperatures above 150° F. and also for liquids above their boiling point (even if below 150° F.). For work that may be turned during welding, tests a and c are used for low pressure and test e for high pressure. For "position welding" tests b and d apply for low pressure and test f for high pressure. Welders who pass the higher-class test are not required to take the lower-class test in addition.

For this reason, the higher-class test is usually employed for power piping, and by general piping contractors. Two or more pipe specimens are required for each welder, and if welding in all positions is contemplated one specimen should be welded in the fixed horizontal and one in the vertical position. In the welding of test specimens, the welding process and procedure, welding wire or rods, and type of equipment must be the same as for the work to be done. Thus if another welding procedure is used in "rolled welding" than that for "position welding," it is necessary to make both "rolled" and "position welded" test specimens.

Specimen Must Be Similar to Pipe to Be Welded

The pipe must be of the same general quality and size as the pipe to be welded, but in no case less than 6 in. nominal size. Frequently the fabricator plans to weld a variety of pipe during the effective period of the tests. The Code does not state the range of sizes that may be welded with a given size of test specimen, but it is logical to make the test similar to the most difficult task to be performed.

For the ordinary range of standard and extra-heavy pipe sizes, this will mean the heaviest wall, regardless of the diameter of the pipe. For example, specimens made of 10-in. standard pipe would cover all standard pipe up to 30-in. nominal size, and specimens made of 8-in. extra-heavy pipe would cover the above range of standard pipe as well as extra-heavy pipe up to the 16-in. size. For pipes having a wall thickness greater than ½ in., it is a good plan to follow the principles laid down in the Pressure Vessel Code for the thickness of test specimens, because these have been in use for some time and have been found to be satisfactory.

In case the Ohio Piping Code, as well as the A.S.A. Code, is involved, the horizontal specimen should be made of 12-in. pipe with a wall thickness of ½ in. For the A.S.A. Code, tests e and f, four test specimens are cut from each weld specimen—namely, one each for outside bend, inside bend, tension and nick-break tests.

Incomplete Fusion and Porosity Are Usual Causes of Failure

As with all other qualification tests, the most frequent causes of failure are incomplete fusion and porosity. The "outside (free) bend" specimen must show an elongation of 15% without developing cracks more than 1/16 in. long. Small defects near the surface, if any exist, cause cracks to develop even when the best of filled material is used. When no defects exist, welds made with the same filler material may show elongations of 25% to 50%. In other words, the "free bend" test is a test for soundness as well as ductility.

The "inside bend" specimen is bent with the inside of the pipe on the outside of the bend, and must bend 90° before breaking apart. Incomplete fusion at the root of the weld will cause this specimen to fail, even when the defect is only 1/32 in. deep.

The nick-break specimen must be rejected if it shows any defect more than 1/16 in. in any direction, or more than six gas pockets (of smaller size) per square inch. Since this specimen may be gas cut to size and nicked with a hack saw without machining, it is a good plan to test it before the others are machined. If it fails, the other specimens from the same pipe should be discarded and thus save delay and the cost of machining and testing. Tension specimens seldom fail if the welds are sound and a suitable grade of filler metal has been used.

Failure in First Test Can Often Be Laid to Mental Strain

The Code requires that a welding operator who fails in the first test must pass two successive similar tests without failure of any bar before he can qualify. The possibility of failure during the first test is quite likely. This is partly due to the mental strain incident to any qualification test, causing the operator to make poorer welds than under normal conditions. But after al-

lowing for this "hazard," one is forced to conclude that when welding is done by men who have not been tested, much of it falls far short of the standard set by the Code.

Of course, that does not mean that all these welds are unsafe under ordinary operating conditions. The Code requires something very close to perfection, while a weld would have to fall far short of this to be no stronger than a threaded connection. But it does mean that it is a mistake to rush into the Code test without preliminary tests. This is perhaps the most important statement in this paper, because it is sometimes difficult to convince a fabricator of this fact until a number of his operators have failed and thus come under the requirement for a double test.

For the preliminary tests, scrap pipe should be welded under conditions similar to the Code test and simple fracture tests made along the lines described by the author in a previous article.* About one-third of the specimens should be nicked as required by the Code, another third along one fusion zone, and the remainder along the other fusion zone. Preliminary bend specimens, if desired, can be made by gas cutting and then removing the reinforcement by grinding (lengthwise of the bar). About half the specimens should be bent in one direction and the remainder bent the other way.

Test Specimens Should Be From Pipe of Known Quality

The specimens for the Code test must not be made of scrap pipe of unknown quality, because the requirement for the ultimate strength of the tension specimen is based on the minimum specified strength of the pipe. Short ends that are suitable for test pieces should be carefully marked and held until required. Otherwise the specimens must be cut from pipe of known quality. Even when all the pieces comply with the specification, the necessary manufacturing tolerance results in considerable variation in physical properties of different lots. Experience has shown that when a piece of maximum hardness is welded to another of minimum hardness, the danger of failure in the bend specimens is increased. For this reason both halves of the one specimen should be cut from the same length of pipe, if possible.

*"Inexpensive Weld Tests," by R. B. Lincoln, *The Welding Engineer*, October, 1935.

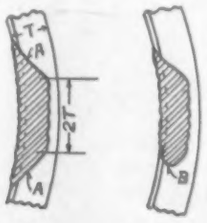


Fig. 1. Designs of Tack Welds.
(Correct weld is shown at left, and defective weld at right.)

Incorrect Beveling or Spacing Handicaps Welder

The beveling of the ends should be carefully done for both the test and the regular work. The included angle should be 90° for gas welding with the "forehand" technic. For the "backhand" method it can be reduced but should not be less than 70°. For arc welding, 60° is satisfactory. The unbeveled portion (shoulder) should not exceed 1/16 in. at any point in the circumference.

In some shops this point is not given the attention it deserves. The tools are adjusted by guessing without the use of gages. The pipe is sometimes out of round and the wall thicker on one side than the other. As a result, the angle is incorrect and the shoulder is too thick at the heavy side. The welder making a test under such conditions has two strikes called on him before he starts, and that is not according to the rules.

The specimen should be spaced the same distance as production welds and be securely tack welded. The spacing is important because, if too great, it will be impossible to avoid "icicles" inside the pipe and, if it is too close, it will be impossible to secure fusion at the narrow part. The contraction in the V is more evident on short test pieces than on the actual work when full-length pipe is used. To avoid troubles, tack the test pieces securely. When chill rings or backing strips are used (for arc welding) so that there is little danger of melting through, the spacing can be more liberal.

Tacks Must Be of High Quality and Correctly Made

If the tacks are not to be melted out, they must be equal in quality to the rest of the weld. The ends should be sloped off as at *A*, Fig. 1. Avoid overlap, as shown at *B*, particularly in arc welding. With gas welding, it is possible to melt away defective tacks, but with arc welding they are likely to remain in the finished welds unless chipped away before welding over them.

For gas welding, any of the standard torches can be used, if in good condition. Welders usually have no difficulty in selecting the correct tip. If the "inner cone" is smooth, with a rounded end, it is good evidence that the tip is in good condition. If the flame is irregular, the tip should be repaired or discarded.

The mixture of the gases is very important. An oxidizing flame burns the metal and causes failure of both the bend and tension specimens. A reducing flame (excess acetylene) causes porous or brittle welds with some welding rods, but is an advantage with others. A slight excess of acetylene that will cause a "feather" 1/16 in. beyond the inner cone is satisfactory with most welding rods, and where it does no actual harm it should be used to insure a non-oxidizing condition. A very slight change in the mixture can be noted by the changed length of the feather, and readjustment made accordingly.

Fig. 2. Defective Nick-Break Specimen.

Neutral Flame Should Be Checked Frequently

When a neutral flame must be used, the mixture should be checked at frequent intervals (10 or 15 minutes) by raising the torch enough to stop melting, opening the acetylene valve enough to show a feather and then readjusting it to exactly neutral. It is a good plan to protect the puddle from the air with the outer part of the flame during this operation.

The regulators should maintain a constant pressure so that when the flame is correctly adjusted it will stay put. Defective regulators, in my opinion, are the cause of many defective welds. The regulator may look new, but even a new regulator can be damaged in a few minutes by abuse.

Welds made with a correctly adjusted flame seldom show evidence of gas pockets. Failure, if it occurs, is usually due to defective fusion between the base metal and the weld, or to cold laps in the weld caused by forcing the liquid metal onto an unmelted surface either by the motion of the rod, the pressure of the gas or by gravity.

Welder May Not Recognize Fusion When He Sees It

When a good welder fails due to one small defect in a free-bend or nick-break specimen, he should not be condemned too severely, but after some additional practice he should be retested. When large areas are not fused, it shows that he is not able to recognize fusion when he sees it.

Fig. 2 is a sketch of an actual nick-break specimen showing a very serious defect. The defect is shown in black and the fracture shaded. In this particular case, about half the area was welded and about half was a cold shut having no strength. There have been entirely too many failures of this class. To avoid such defects liquid metal must always be added to liquid metal, and when that is done there can be no incomplete fusion. The forward edge of the molten pool should advance nat-

urally due to the melting of the metal and never be forced forward onto the unmelted metal.

When conducting tests, I have tried to observe which methods lead to success and which ones to failure. Backhand welding seems to give best results when welding a pipe with the axis vertical. Either the backhand or forehand method seems to be satisfactory for horizontal pipes.

Inner Cone of Flame Should Not Be Too Far Away From Pool

As regards the distance of the flame from the pool, about ⅛ in. from the inner cone to the pool seems to give good results. Some welders hold the inner cone ½ to 1 in. away, doing the actual melting with the outer flame. The heat is spread over so large an area that a large pool of metal forms which cannot be controlled unless it is kept cold enough to be semi-liquid. This practice seems to result frequently in failure. I have also observed that welders who can carry a pool along without raising the torch and allowing it to freeze (except when necessary to change rods) have better success than others who are frequently lifting their torch.

Undercutting is not permitted by the Code, but it is a defect that may easily be seen and corrected during welding. In spite of this, some operators turn in specimens that must be rejected for this defect.

For arc welding, a coated electrode is needed to give the ductility required by the bend test. For position welding it must give sound deposits in the vertical and overhead positions. It is important that it produce a reasonably smooth bead, because a rough surface is likely to cause defects in the next bead deposited over it.

The surface of the bevel and the chill ring (if used) must be free from oil, dirt or rust, particularly if small electrodes are used. It may be possible to burn through a certain amount of foreign matter with 3/16-in. or ¼-in. electrodes, but it is best to be on the safe side.

25 to 40 Volts at the Arc Gives Best Results

Coated electrodes suitable for this work usually give best results with 25- to 40-volt arcs (depending on the nature of the coating). Many old-style generators designed for bare-wire welding and rated at 25 volts do not maintain a steady arc on coated wire. The probability of success will be greatly increased by using a modern generator rated at 40 volts. The generator should be in good condition. Loose connections, or brushes and commutators in poor condition, can cause weld failures.

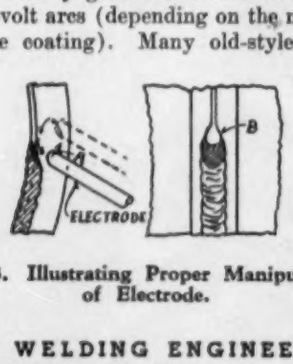
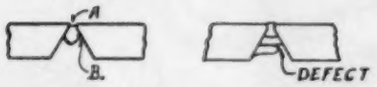


Fig. 3. Illustrating Proper Manipulation of Electrode.



Figs. 4 and 5. Defects in Weld Beads.
(Fig. 4, at left, shows unwelded part of root at A, and at B is a depression between the bead and the side of the bevel.)

If no chill ring is used, the edges should be spaced 3/32 or 1/15 in. apart and tacked securely to prevent closing. ⅛- or 5/32-in. coated electrodes are used for the first layer. Some operators start at the top and weld down while others work from the bottom up. Both methods are successful, but my observations would favor starting at the bottom and using the motion shown in Fig. 3. The arc is lengthened and at the same time moved forward, as shown by the arrows at *A*, so as to preheat the surface. It is then shortened and the electrode moved back to the molten pool. With this method it is possible to burn a small opening like a keyhole, as shown at *B*, and avoid any unwelded part at the root, like that shown in Fig. 4 at *A*. Penetration is so complete that some of the welds look very much as if a layer had been deposited on the inside.

Beads Should Be So Laid as to Make Slag Removal Easy

Avoid, if possible, a high bead with a sharp depression between the bead and side like *B*, Fig. 4. It is very difficult to remove all the slag and to melt to the bottom of this space in the next layer. If this shaped bead is formed, even for a short distance, it must be either melted out with a long arc or chipped out.

Subsequent layers on pipe up to ½ in. thick (with axis horizontal) are usually deposited by weaving the full width of the groove. For thicker pipes it may be necessary to use two or more beads in each layer. In this case, it is necessary to avoid any lap or roll at the edge of the bead (see Fig. 5). If this does occur, the defect should be chipped away before depositing the next bead, because it is not always possible to burn through it.

When the pipe axis is vertical, the weld should be built up in parallel beads, care being taken to avoid overlaps or narrow spaces where the arc will not fuse to the bottom when depositing the next bead.

In conclusion, I would point out that this Code, in common with most of the new codes, demands a degree of perfection considerably above that thought possible or necessary a few years ago. It may seem difficult when making the first attempt to meet the standard, but the large number of men that have passed the test proves that it is possible. There is no doubt that poorer welds could be used on some classes of work, but the difference in cost is so small that it is usually more economical to decrease the size of weld, rather than to lower its quality. For this reason it seems likely that an increasing percentage of the work will require compliance with the Code in the future.

200 Enroll for Welding Course in St. Louis

A course of instruction in arc welding, promoted by the Washington University School of Engineering and University College, was held recently at Sheldon Memorial, 3646 Washington Ave., St. Louis, Mo. More than 200 engineers, designers and production executives and supervisors of welding operations in St. Louis enrolled.

The course included the application of arc welding to building and home construction, ship-building, and heavy machine design. Five evening lectures were given by E. W. P. Smith and Robert E. Kinkead, both of Cleveland, Ohio. Demonstrations were held during the afternoons of the last four days and free consultation service was offered in the mornings at the Hill Equipment Engineering Co., 4620 Delmar Blvd. The School of Engineering furnished special equipment for the course.

Chicago Section Promotes Lectures on Metallurgy

A lecture course on "The Fundamentals of Metallurgy as Applied to Welding," in charge of Jules Muller, consulting engineer, Chicago Steel & Wire Co., one lecture of which will be given at each of the coming meetings of the Chicago Section of the American Welding Society, is being promoted by the Section as an educational venture and in an effort to increase the Section's membership.

At the meeting of the Section on Nov. 22nd, to be held in the Illinois Room in the Palmer House, Mr. Muller's lecture will be given from 7 to 8 p. m., followed by a paper, illustrated with slides, on "Welding in Structural Steel Repair and Modernization in the Chicago District," by J. M. Jardine, proprietor, Western Welding & Boiler Repairing Co. Then will come a talk by G. F. Goddeau, of Gasweld & Airway, Inc., on the air-acetylene torch and the application of the air-acetylene flame to the brazing of pipe slip-joints, copper work, and other jobs, followed by a demonstration of the torch on various work.

Welding Industry Loses Pioneer

Death of Eugene Bournonville, picturesque character, recalls his early work in oxyacetylene welding and cutting, as well as others of his exploits. . . . . .

EUGENE BOURNONVILLE, generally known as the "father of oxyacetylene welding in America," and also as an organizing partner of the Davis-Bournonville Co., of which he was formerly vice-president, died on October 14th at his home in Jersey City, N. J., where he had lived for the past 30 years. His death at the age of 73 resulted from complications following an illness of more than five years in extent. Surviving him are his wife and his two sons, Maurice and Rene, who had been associated with him in various enterprises.

Bournonville has been identified with acetylene developments since 1895. His first patent, which was applied for in 1897, protected his design for an automatic generator—one of the first devices of its kind to be patented, and the first to add the carbide to the water instead of adding water to the carbide.

Following upon a visit to Europe in 1900-01, Bournonville next arranged in Paris for the procurement of American patents to protect the design of Edmond Fouche's safety cylinders for the storage of explosive gases; and he also arranged to have these patients assigned to himself and to John S. Seymour, a former United States Commissioner of Patents, and to Commodore E. C. Benedict, the distinguished New York multimillionaire financier who was so prominently identified with gas-lighting in its hey day. As consulting engineer for Benedict's firm, the Commercial Acetylene Co., of New York, Bournonville became well acquainted with Grover Cleveland, who had just completed his second term as President of the United States. This friendship grew into a jolly camaraderie in which Bournonville and Messrs. Cleveland, Seymour and Benedict often convened for dinner and cards at the Benedict mansion in Greenwich, Conn.

Son of Wealthy Belgian Mine Operator

Bournonville was born in Ethe, Belgium, on Feb. 2, 1862, the son of an influential and prosperous mine operator and contractor who was identified with the construction of many of the most famous buildings in Brussels. After completing his studies at the colleges of Carlsbourg and Alsemberg, he left a home of luxury in Europe to become a citizen of the United States and to serve as a non-commissioned officer in the U. S. Navy.

It is not unusual in Europe to be trained to more than one profession; but many of the acetylenists in this country who have observed Bournonville's engineering career since 1895 will be surprised to learn that he was also an accomplished chef with a following among epicures, having once been in charge of the cuisine for the famous old Astor House of New York City, as well as chef in charge of affairs for the opening of the Jefferson Hotel in Richmond, Virginia.

After learning the English language through the practical expedient of first-hand contact with it in energetic American living for several years, Bournonville began his engineering career as president of the General Acetylene Co., from 1898 to 1901; and from then until 1905 he was chief engineer for the Commercial Acetylene Co., of 80 Broadway, New York. While in the latter position, he devoted most of his time to perfecting the means for making the daily use of acetylene safe in the hands of the average individual—a hazardous research in those days, which kept his life in constant danger. There were innumerable and even miraculous escapes from violent explosions which wrecked buildings in several instances, and which proved fatal to some of his associates and friends. Nevertheless, he continued fearlessly to devote himself to the perfecting of the safety cylinders which are now so familiar to engineers throughout the world. Upon the successful completion of this work, he spent the next two years experimenting with developments pertaining to oxyacetylene welding, having become interested in this new field of science in 1903, after his success with the first actual welding ever done in the United States by means of acetylene torches.

Joins With Davis to Organize Davis-Bournonville Co.

The Davis-Bournonville Co. was formed early in 1907, with Augustine Davis as president and Bournonville as vice-president. Bournonville sold out his entire interest to Davis in 1910 in order to organize the Bournonville Welding Co., of New York City, a firm which today is one of the largest companies of its kind in the country. Some years later, the Davis-Bournonville Co. was acquired by the Air Reduction Sales Co.

While associated with Davis, Bournonville concentrated upon experiments to improve and develop torches, in which the oxygen consumption was finally reduced to nearly the theoretical figure for perfect torches; and along with this research, he also devoted himself to the discovering of the proper welding techniques required to meet the new problems which presented themselves daily. Likewise he found it necessary to shrewdly pioneer in applied psychology in order to overcome a persistent skepticism in the mechanical world, which at first resisted the new welding developments and all proofs of their merits with an almost superstitious attitude, as though the new science exploited the tricks of magicians or devils.

Leaves Welding Field to Engage in Research on Rotary Valves

Bournonville retired from active participation in the welding field in 1912, in order to devote all his time to automotive research pertaining to rotary valves and their baffling problems, which have intrigued all the famous automotive engineers in the world, including Henry M. Leland of Lincoln and Cadillac companies, Colonel Vincent of Packard and Liberty-motor fame, and Fred S. Duesenberg. In 1914 Bournonville bought J. P. Morgan's Fiat car and completely redesigned and rebuilt it for experimental study; but after 70,000 miles of such experience, this work was interrupted in 1917 while he trained welders for the American Army at the front, besides also serving as a dollar-a-year man in charge of manufacturing poison-gas containers.

After the War, he organized the Bournonville Rotary Valve Motor Co., a research group devoted to many phases of experimental engineering, and of which he was the president until his death. Some of the cars that Bournonville built as long ago as in 1922 (and which featured ingenious welded constructions and

the frequent soldering of copper to cast iron by a process of his own invention) are still in daily operation after having run more than 200,000 miles without any servicing to the feature of his engine development, which is a design for the elimination of poppet valves and more than 100 parts from the conventional automobile engine.

Bournonville's active engineering interest in automobiles dates back to his ownership of one of the first cars in the United States—a car that Albert Champion, his racing friend of AC sparkplug fame and presidency, used to enjoy driving in his youth with verve and dash. It is incidentally interesting that the famous Indianapolis race track traces its existence back to Bournonville's enterprise in licensing Mr. Avery of Milwaukee to develop acetylene; for it was the latter's success in this business that attracted and tempted James Allison and Carl G. Fisher to enter the field so brilliantly with Prest-O-Lite. Fisher had formerly been both a bicycle and an automobile racer of note; so it was quite natural, in 1909, that he should utilize a share of his rapidly acquired acetylene profits to build the famous speedway in his factory dooryard, besides also conceiving and promoting the Lincoln Highway with other of his acetylene profits.

Bournonville made more than 35 trips between Europe and the United States in connection with his varied engineering enterprises; and more than 50 successful patents have been issued in his name, the latest having been granted in 1934. Elwood Haynes died at the time he was arranging to manufacture cars featuring Bournonville's engine design. Later, in 1928, the Minerva Co. of Belgium was tooling up for production of a high-speed Bournonville engine, but they were forced to abandon this program upon the deaths of both their president and their chief engineer within a few months of each other, immediately prior to the depression. Bournonville's own death has now interrupted his recent negotiations for an American application of his engine to heavy-duty trucking.

As a member of the International Acetylene Association, and of the Society of Automotive Engineers, Bournonville lectured extensively in both this country and in Europe, relative to the developments and the progress of the inventions with which he had been connected. His work has been widely publicized in the engineering periodicals of this country, and in those of England and Germany.

The outstanding details of Mr. Bournonville's work in connection with the early use of the oxyacetylene torch are given in an article on pages 22 to 24 in the June, 1935, issue of *The Welding Engineer*.

Book Reviews

CAST METALS HANDCOOK. First edition (1935); 6x9 in.; 512 pages; 130 illustrations and 128 tables. Flexible binding; price, $4.00. Published by the American Foundrymen's Association, 222 W. Adams St., Chicago, Ill.

Manufacturers and fabricators of metal products should acquaint themselves with the recent developments in castings with a view to seeing if they can cut costs or make better products. More than likely, new castings will find their way into many products that at present are built of rolled steel or of low-quality castings.

Metallurgists are taking a whack at casting problems, and here is one of the results: By means of alloy additions, gray cast irons have been produced having tensile strengths exceeding 70,000 lb. per sq. in. and a modulus of elasticity reaching 30,000,000 lb. per sq. in. Now days when one speaks of gray cast iron, either low- or high-strength iron should be specified, to eliminate any chance for misconstruction.

Exclusive of the index and advertising section in the back of the book, this volume devotes a section to each of the following: Recommendations to designers of castings; recommendations to buyers of castings; cast iron; malleable cast iron; cast steel; and non-ferrous casting alloys.

In those sections devoted to the several types of castings, consideration is given to physical properties and their control, electrical and magnetic properties, growth, machinability; resistance against wear, corrosion and heat; heat-treatment, effect of elements on properties and structure, specifications, and uses.

The section on non-ferrous castings includes information on alloys with bases of copper, aluminum, magnesium, lead, tin, nickel, and zinc-base die-casting alloys.

Those who were entrusted with the compilation of this book deserve the thanks of the metals field for the manner in which they have correlated the data, bringing it up to date, and for correcting erroneous and obsolete data that many engineers had heretofore accepted without question.

* * *

PROCEDURE HANDBOOK OF ARC-WELDING DESIGN AND PRACTICE. Third edition; 6x9 in.; 596 pages; 714 illustrations and many tables. Flexible binding; price, $1.50. Published by The Lincoln Electric Co., Cleveland, Ohio.

This new edition of a book that has become well known since the first edition was published two years ago, is some 140 pages larger than the preceding edition, and includes the following new information: American Welding Society specifications for filler metal; method of determining the amount of current carried by the electrode; procedures, speeds and costs for making all types of welds in sheet metal; A. S. M. E. Boiler Code requirements for butt welds in heavy plate; hard-facing of ferrous metals; additional examples of redesigning for arc welding; use of arc welding in making and repairing cutting tools and dies; speed of welding oil and gas pipelines; and other information.

This book covers quite thoroughly the field of arc welding, including such topics as welding methods and equipment, technique, procedures, speeds, costs, structure and properties of weld metal, weldability of various metals, designing for arc-welded steel construction of machinery and for arc-welded structures, and typical applications of arc welding.

* * *

COURSE OUTLINE IN METALLOGRAPHY FOR WELDERS, by W. C. Cumming. 6x9 in.; 72 pages; 42 illustrations and 9 tables. Paper binding. Published by the State Department of Vocational Education, Lincoln, Nebr.

Starting with a general explanation of what is meant by metallography, and defining a mixture, solution and chemical compound, so the student can distinguish between them, the author leads into the theory of the combination of atoms to form metallic alloys, followed by examples of constitution diagrams to fit each of the three classes of alloys—those whose constituents are completely soluble, those whose constituents are completely insoluble in each other in the solid state, and those whose constituents are partially soluble in each other in the solid state.

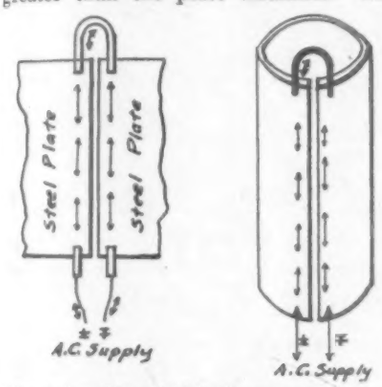
Then follows a discussion of the chemistry of iron and carbon, with an explanation of the iron-carbon constitution diagram, with an interpretation employing examples representing five different transformations. Other chapters pertain to heat-treatment and its effect on the structure and properties of iron and steel, control of grain size, effect of impurities and alloying elements, cast iron and its properties, interpretation of micrographs, fluxes and their action, metallography of the welding of non-ferrous metals, laboratory exercises, and sources of material.

The fundamental facts regarding the behavior of metals when they are fabricated by welding are made easy to understand by employing a simple text, explanatory diagrams, and logical presentation of data. The welder needs no special knowledge of chemistry or metallurgy before taking up the study of this book.

Resistance-Welding With High-Frequency Current

A resistance method of welding is in course of development which takes advantage of the "skin effect" of a high-frequency current.

High-frequency current tends to flow only on or near the surface of the conductor, and two parallel circuits flowing in opposite directions are attracted to each other. If two plates are slightly separated and high-frequency current is passed through them, as shown in the sketch, the current will flow close to the edges of the plates and will heat the metal close to the edge only, raising the edges to a welding heat, without spreading back into the plate for a distance greater than the plate thickness. The



Illustrating How High-Frequency Current Is Used for Welding.

frequency may be 30,000 or 60,000 cycles per second, or more. The localized effect increases with the frequency.

It is said that this method is successful on pipe or adjacent edges of any metallic material. The edges may be flooded with protective gas, if desired, to prevent contamination by the atmosphere.

Eight Welded Barges Being Built in Portland, Ore.

The sixth in a series of eight 125-ton all-welded steel barges for the Western Transportation Co., subsidiary of Crown-Willamette Pacific Co., was launched this month. The builders are the Commercial Iron Works, Portland, Ore.

Four of the barges were built last year and the remainder are being constructed this fall. They are the first all-welded steel barges of this type to be used in the Portland district. They draw 18 in. of water light and about 6 ft. when loaded with 700 tons of cargo. Each barge is 145 ft. long, with a 40-foot beam, and costs about $20,000.

A specially designed all-welded tug, 45 ft. long and powered with a 120-hp. Atlas Imperial Diesel engine, is almost completed. The tug also was ordered from Commercial by the Western Transportation Co.

Texas College Will Hold Second Annual Conference

The Texas Technological College, Lubbock, Texas, announce that their second annual welding conference will be held on Thursday and Friday, Feb. 13 and 14, 1936. Indications point to an attendance of over 500. It is expected to have lectures and pictures during the morning sessions and the Thursday evening session. Demonstrations by the exhibitors will consume the entire afternoon of both days.

A Welding Engineer's Wife Speaks Her Mind

■ By MILDRED KINKEAD

"Profits of Progress"

Cleveland was host last week to the 36th annual convention of the International Acetylene Association, which brings hundreds of distinguished and agreeable visitors to the city.

Plenty of other writers will do justice to the technical affairs of this convention. I am concerned with the people. They are commanding. For four days I watched old friends and new ones swarming into the hotel headquarters, and I'm ready to declare that our welding industry represents the cream of the world's crop of charm and distinction. Although primarily this is a meeting of acetylene-minded people, yet all schools of welding-thought mingled harmoniously in Cleveland last week. The intent in every one's mind was to advance the interests of welding as a whole, without aggressive partisanship regarding method.

The entertainment committee put on an excellent four-act play at Music Hall Tuesday night. "Profits of Progress," it was called, and although Author Wilfred P. Burglund indubitably dragged in welding by the very hair of its scalp to rescue a touchy business situation, still he did the dirty work with a nice sense of theater values. The play had plenty of humor; there was some good subtlety in the ensemble of engineering opinion about welding as the Way Out.

Every member of the cast deserves a big hand! Among the characters most enjoyed were President Robinson, of the Robinson Engine Works, played by T. M. Hamer; George Tobin, played by G. V. Slottman; and Harry Page, taken by J. C. Carter. These parts had special humorous business to fatten them.

President Robinson did not have to make up his mind alone about going into welding to build a new automobile engine and save his biggest customer, who was planning to break away from the stodgy Robinson line. Mr. Robinson had right, left, and middle-of-the-road gentlemen to advise him. He turned to the extreme left, ordered oxyacetylene equipment swiftly (oh, very swiftly, Mr. Author!), built the new engine, saved the job, and got away light-hearted to golf.

The play was very well acted and staged. Aside from a balky curtain, and some loud thumps during scene-shifting that made Clevelanders shiver with recollection of last week's honest-to-gosh earthquake, the performance was one hundred per cent smooth. Two pretty gals in the cast had the poise of experienced actresses.

People were talking about the play in the lobby afterward. They got a great kick out of Robinson with his stowaway bottle and his explosive command to his staff to get busy and build the new engine while he played golf; and George Tobin, whose cigar-chawing and stoop-shouldered shamble as he went about croaking pessimistic warnings, were amusing.

Did Mr. Burglund intend his welding shop scene to be symbolic? It might be taken that way. The picturesqueness of welding operations is well known, but "Profits of Progress" went a step beyond the chiaroscuro effects familiar in welding photography, and produced an artistic outcome of another sort. By means of the operators' bodies, and the flame and spark motives produced by their torches, there was created a dynamic picture of welding men at work. The group had a little of a sculptured quality, given added vividness by the play of light upon the faces.

I have no way of knowing whether this posing was meant to be artistic or not, but if one's senses accepted it so, "Profits of Progress" might have the alternate title, "A Study of Welders at Work."

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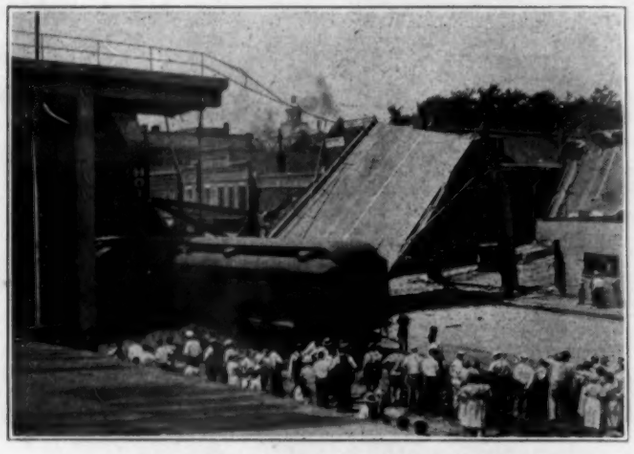
The Talk O' Welding Town

Visitors at our house lately have included:

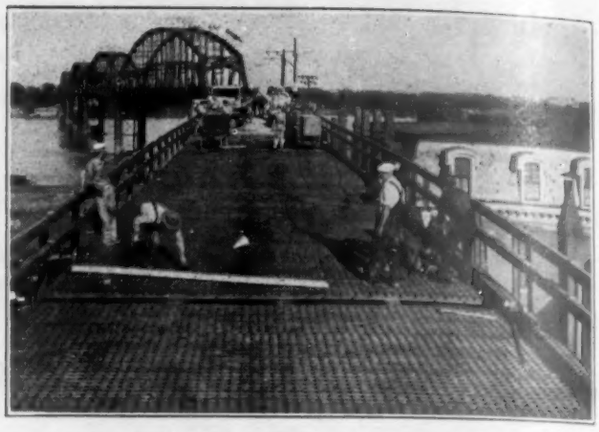
Mrs. Everett Chapman, good-looking wife of Lukenweld's vice-president, of Coatesville, Pa. The lady's an artist, and last year furnished several exhibitions with celluloid models of Lukenweld's welded structures. They're clever; now in a collection in the office of R. W. Wolcott, president, Lukens Steel Co., Coatesville.

R. P. Tarbell, manager welder sales, Ideal Electric & Manufacturing Co., Mansfield, O. Mr. Tarbell is just back from a three-weeks' stay in Dallas, Texas, for his company.

O. P. Hanchette, welding wire division, Joseph T. Ryerson & Son, Inc., Chicago. Mr. Hanchette looks very hale and youthful indeed.



Runaway Car Snaps Off Bridge Columns.



Applying Lock Steel Flooring to New Bridge Spans.

Damaged Highway Bridge Repaired by Welding

The application of arc welding as an expedient and satisfactory solution to bridge repair was very advantageously illustrated in the case of a highway bridge spanning the Missouri River at St. Charles, Mo.

One day last June, seven railroad cars, one of which was a baggage car, became disconnected from the main train, probably through switching, and ran wild for probably a half mile down grade. They crashed through a switch-track-end stop, sheared off the concrete-covered columns at one end of a 60-ft. steel truss of the bridge, and then continued a short distance, piercing the walls of a hotel as one of the illustrations shows.

The columns at the other end of this span slowly bent, permitting this span to let down gradually. At the time this span was coming to rest, it had on it an automobile carrying two men and one pedestrian, who were rather badly shaken and bruised.

As the support of the adjacent 35-ft. concrete span was pulled out, this span collapsed with a roar, the free end swinging around and knocking out the next concrete piers, which in turn released an additional 22-ft. span. Fortunately, no traffic was then on this portion of the bridge.

The adjacent span to the other end of the 60-ft. span was connected through an expansion joint, permitting it to remain through this continuous destructive action. If it too had failed, the remainder of the bridge might have fallen in continuous motion, just as those spans already mentioned.

With due consideration to the possibility of the erection of a one-way wooden structure within 10 days to open this important St. Louis-to-Kansas City highway, the Stupp Brothers Bridge & Iron Co. was awarded the contract to erect a permanent structure, as shown, within three-weeks' time.

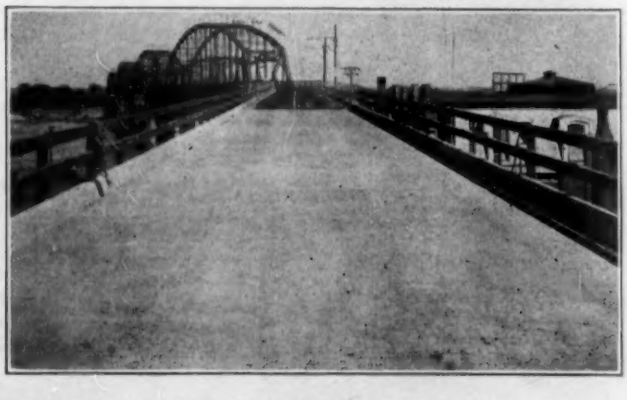
This new structure was built by the use of steel beam supports to replace concrete supports and truss members built up at the site. As much welding as was feasible and logical was employed.

View From Below of New Span.

The largest single factor of expediency in opening traffic on this bridge was the application of an I-beam lock steel flooring. This was welded to the steel stringers.

Two 300-ampere General Electric gas-engine-driven welders and Type W-22 G-E heavy-coated welding electrodes were used.

When traffic was resumed the cross bracings were entirely revised by completely welding all connections. This permitted clearance for the opening of the street directly below, which was closed up following the accident.



View of Bridge, Erected in Three-Weeks' Time by Aid of Welding.

Reclaims Expensive Forgings With Butt Welder

By R. L. BRIGGS
Thomson-Gibb Electric Welding Co.

Before precision standards were widely adopted by every automobile manufacturer, one of the leading companies used to dramatize the accuracy which they maintained in making parts by dismantling several of their cars, mixing the parts in a single pile, and then putting them back together again. When the cars drove off, no one could say which one contained any particular part.

As far as we know that trick never failed to impress the spectators, but can you imagine the embarrassment of the manufacturer if somebody slipped and many of the parts refused to go together? Something almost as bad happened not long ago in a plant making parts for a well-known car.

A forging die for a yoke-shaped clutch release had been completed and several thousand forgings struck off before it was discovered that one part of the piece was several degrees out of line. Errors like this can happen in the most carefully operated plants. This one caused a particularly bad headache. Forging dies cost real money, particularly one as large as this, and the cost represented by the parts already forged and ready for finishing was no small item.

The combination of a bright idea and a butt welder turned this terrible mistake into nothing more than an unpleasant experience. The forgings were

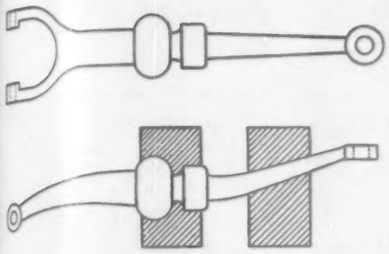


Diagram of Forged Yoke, Showing Method of Bending.

clamped in the butt welder, using a simple die to take care of the angle, and brought to a temperature of 1200° to 1500° F. Then they were bent to the exact angle required for any one of several car models by a simple fixture. Heating and bending in this way did no harm to the forging.

This solution proved completely satisfactory in more ways than one: It salvaged the stock of forgings on hand. It provided a way to substitute one standard die for several, since any desired angle could be produced by this method. And the actual cost to the manufacturer was practically nil because the equipment used was a standard machine that could be adapted to many other operations by adding motor-controlled pressure devices or air-operated clamps. In other words, if one figures that the cost of the butt welder was cancelled by its usefulness on other work and by the fact that it saved the cost not only of the faulty die but several others, then the net cost to the manufacturer was the cost of current for heat—which is a mighty small item.

Stainless Steel Is Subject of New Sound Movie

The first sound picture made on the manufacture, fabrication and application of stainless steel has just been released by the Republic Steel Corp., Youngstown, Ohio. The picture, entitled "Enduro, Republic's Perfected Stainless Steel," consists of four standard reels, and the production scenes were taken at the Republic plants in Canton and Massillon, Ohio.

The picture makes use of off-screen narration to describe in chatty, non-technical language the story of stainless steel. Beginning with the mining of its principal component parts, such as chromium in Rhodesia and nickel in Canada, the film traces the various steps in the manufacture of the alloy. Particularly spectacular are several shots showing the handling and pouring of hot metal from giant electric furnaces.

After the production story has been told, the film demonstrates the welding, soldering, spinning, drawing, stamping and forming of stainless steel, and installations and applications are shown.

Dentist's Mirror Makes Good Inspection Tool

Hard-to-locate cracks in objects to be welded may oftentimes be found by using a dentist's mirror, says P. T. Shaver, shop manager for Chas. A. Jensen, Los Angeles welder.

The mirror is of the type used by dentists in examining behind molars. It has a 6-in. handle, to which a small magnifying mirror shaped like the bowl of a round soup-spoon is attached. The mirror may be used in inspecting such surfaces as the inside of cylinder walls on motor blocks, along frames where protruding angle irons or small clearances prevent the welder from seeing clearly, and other points where the mirror is desirable for its periscopic effect. Therefore, a dentist's mirror is regular shop equipment at this firm's place of business.

Builds All-Welded Brine Tanks for Ice Plants

The all-welded brine tank built at Woodruff's Ice House, Peoria, Ill., by the Superior Welding Co., same city, has been completed. This tank is 23 ft. 6 in. wide, 31 ft. long, and 4 ft. 6 in. deep. It weighs approximately 12 tons and has a 25-ton ice capacity. It has a reserve water tank of about 18,000 gallons, and a small filtering tank, about 2 ft. in diameter and 4 ft. long. There are also three fuel tanks for supplying the Diesel engine.

A contract has been awarded the Superior Welding Co. for an all-welded brine tank for the Starks Ice Co. at Pekin, Ill. This tank will be 21 ft. wide, 41 ft. long and about 5 ft. deep. Work of removing the old tank is going forward and construction of the new one is expected to start momentarily.

Cleveland School of Welding Forms Alumni Association

The Cleveland School of Welding Alumni Association was formed in Cleveland, Ohio, on Oct. 24th at a meeting held at the Cleveland Engineering Society rooms. There was an attendance of 70 ex-students of the school.

This meeting was for organization and for adopting a constitution, as well as electing temporary officers to serve until April, at which time the annual meeting will be held and permanent officers will be elected for the ensuing year. Meetings will be held monthly.

The constitution states that the organization is nonpolitical. Also, union and labor questions are barred from coming before the group for discussion. The aim is to create good fellowship, help the unemployed, and further welding knowledge.

The coming meeting on November 19th will be held at the plant of the Gas Products Co., in Cleveland, who will act as host. There will be a talk by an executive of the Chicago office and demonstrations.

Nebraska Blacksmiths View Welding Demonstrations

Welding demonstrations attracted a great deal of interest during the 29th annual convention of the Nebraska Blacksmiths' Association, held in Omaha, Oct. 30th to Nov. 1st. The Omaha Welding Co. and The Balbach Co. were particularly in evidence. Other manufacturers and dealers represented included the New Process Plow Welding Co., Peterson Welding Laboratories, The Linde Air Products Co. and Haynes Stellite Co. A 400-lb. arc-welded lid for a brewery tank, made by August Warholowski, Columbus, Nebr., won one of the prizes offered for the best samples of workmanship.

San Francisco Group Views Movie on Metal Spraying

The San Francisco section of the American Welding Society met on Oct. 25th. A special feature, in addition to the regular business session, was an interesting reel of motion pictures shown through the courtesy of the Victor Welding Equipment Co., which showed some uses of metal spraying. An interesting period of questions and answers followed the showing of the film.

Have You Seen This Man?

Name, Ralph H. Keeley; also known as Ralph Hunter. Age, 42; height, 5 ft. 10 in.; weight, 160 lb. Blue eyes, brown hair. Wife has not heard from him since he left his place of business in Lincoln, Nebr., last March 27th, traveling east with a '26 Model Ford truck and 2-wheel trailer, carrying a welding machine. Anyone knowing his whereabouts will please send information to Mrs. Keeley, at 635 South 9th St., Lincoln, Nebr.

Muff Joints Used in Switzerland Penstock

A Swiss manufacturing firm, Sulzer Brothers, have made an installation of about 6½ miles of parallel high-pressure penstocks in connection with a Swiss hydroelectric power station, a noteworthy feature of which is the use of machine-formed muff joints. This type of joint is electrically welded and permits testing under water pressure without requiring that the penstock itself be subjected to pressure.

The power station in question is the Dixence hydroelectric development in the Valley des Dix. The reservoir dam is situated at an altitude of 7350 ft., and the power plant at an altitude of 1635 ft., so that a head of 5740 ft. is utilized in a single stage. Power is developed by five a.c. generators. Each generator is rated at 30,000 kw. and is driven by two single-jet Pelton wheels, each wheel rated at 21,250 hp.

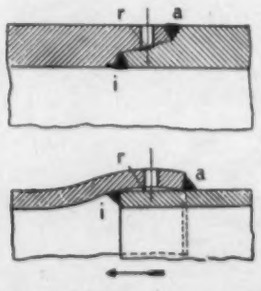
A concrete-lined pressure gallery, 7½ ft. in diameter and nearly 7½ miles long, extends from the intake at the reservoir dam to the control valves at the top of the penstock, with a grade of 2%. It is cut through rock for a distance of about 7 miles to the pressure-equalizing shaft, and from this shaft the remaining 1452 ft. of pressure gallery consists of steel pipe, 6½ ft. in diameter, with a grade of 1%. When the reservoir is filled and the turbines are not running, the water pressure in the gallery rises to 202 ft. water gauge at the intake and to 292 ft. water gauge at the lower end.

The 6½-ft. pipe forming the lower portion of the pressure gallery divides at its lower end into two parallel high-pressure penstocks. Division is accomplished by means of an arc-welded wye, having an intake diameter of 6.56 ft. and outlet diameters of 4.66 ft.

Each of the two parallel penstocks is approximately 18,000 ft. long, with a diameter of 56 in. at the upper end, which decreases gradually to 38¾ in. at the distribution pipes in the power station, and a wall thickness ranging from 0.4 in. at the upper end to 1.6 in. at the lower end.

The 1800 separate sections of pipe making up these two parallel penstocks were connected by arc welding, using Sulzer muff-testing joints. These muff joints are welded electrically both inside and out, and are so designed that they can be tested for leakage without it being necessary to place the entire pipeline under pressure. The erection of the penstock is therefore greatly simplified and accelerated. The working pressure of these pipelines is 2489 lb. per sq. in., and in testing the joint is subjected to 1½ times the service pressure expected at the different points in the pipeline.

The muff joints are formed on bending machines in the case of pipe with wall thickness up to 0.5 in. For a wall thickness of 0.5 to 0.9 in., a 200-ton press is used. For wall thicknesses of over 0.9 in., the pipe joints are machined. Muff joints are omitted in the connections of special cast steel parts, such as expansion joints and bends, which are made with flanges and bolts. The maximum weight of a single pipe section is 15 tons.



Sections of Muff Joints for Piping.
(Upper joint for walls over ⅞ in. thick, and lower joint for smaller thicknesses.)

Health Laboratories Erect All-Welded Building

An all-arc-welded 3-story building, 40 ft. long, 20 ft. wide, and 35 ft. high, has been completed for the Spr-Hei Laboratories, of St. Louis, Mo., the welding being done by the Mechanical Welding Co., 1906 Delmar Blvd., of which C. N. Sloane is proprietor.

All-Welded Framework for Three-Story Building.

Channels and T's were used for the superstructure, 8-in. channels for the lower portion and 4-in. for the upper portion. Side sheets of steel were welded on the inside and outside of the framework, leaving a 4-in. space for insulation. All windows and sashes were arc welded, no bolts being used at any time during course of construction. All hinges also were welded in place. The welding was completed in 10 days.

This building, which was erected more or less as an experiment, has proved so successful that three others like it will be built soon, all four being arranged in the shape of a cross, with a court in the center, which will be roofed over and used for administration purposes. The completed building will be used as a private hospital or sanitarium. The structure is on state highway 99, in St. Louis County.

Santa Fe Orders Welded Stainless-Steel Coach

An order for a de luxe day coach of lightweight, stainless steel construction, the first of its kind to be built for any railroad, has been placed with the Edward G. Budd Manufacturing Co., Philadelphia, Pa., by the Atchison, Topeka and Santa Fe Railway. The car, which will be of standard size and width, will weigh only half as much as a conventional steel coach. This saving of weight is significant, officials of the Budd company said, in that with a train of stainless-steel cars, double-header locomotives would not be necessary for long hauls on mountainous runs. Plans for the car, which is being built by the Budd "Shotweld" process of fabricating stainless steel, were prepared under the direction of John Purcell and Charles T. Ripley, Santa Fe executives.

Talks on Structural Welding and Building Codes

"Structural Welding in Relation to Building Codes" is the topic to be considered by the New York Section of the American Welding Society at a meeting at 8 p. m. on Nov. 26th, in Room 501, Engineering Societies Building, 33 West 39th St.

Explaining the purpose of this meeting, F. H. Frankland, chairman of the committee which arranged it, says: "This meeting has for its purpose an expression by various interests of their views regarding the relationship of structural welding to building codes. Short expressions of these views will be given by building officials, consulting structural engineers, steel fabricating engineers, erectors, and inspecting engineers."

The meeting of the Section on Dec. 17th will be given over to the subject of "Stainless Steel and Aviation," and the newly completed 4-reel sound film of the Republic Steel Corp. on the manufacture of stainless steel will be shown.

I. A. A. Holds Successful Convention at Cleveland

While the attendance at the 36th annual convention of the International Acetylene Association, held at the Hotel Cleveland, Cleveland, Ohio, on Nov. 12th to 15th, did not quite equal last year's, the exceedingly high quality of the authors, reputation of the speakers, interesting subjects which made up the four-day program and the high type of those attending the sessions, made it probably the most successful of all the Association's conventions.

The attendance was divided as fol-

lows: Technical sessions, 768; "Profits of Progress" drama, 1250; and the "Welding and Cutting Forum," 1175; total, 3193. Of the technical sessions the Wednesday program, under the subject "Metallurgy of Welding and Cutting," proved the most popular, based on attendance, with the Thursday session on "Piping and Pressure Vessels" running second.

The presentation of the Morehead Medal, awarded annually by the association in recognition of valuable services rendered the industry, was presented by H. B. Pearson, past president of the Association, to Worthy Channing Bucknam for his very valuable developments of many motor-driven oxyacetylene welding and cutting machines.

At the annual luncheon and business meeting held on Nov. 14th, the several committees rendered reports, and new officers were elected. C. O. Epperson, of the Keith Dunham Co., Chicago, Ill., was unanimously elected president for the coming year; C. D'W. Gibson, Air Reduction Sales Co., New York, was elected vice-president; Henry Booth, Shawinigan Products Corp., New York, was re-elected treasurer; and H. F. Reinhard, New York, was re-elected secretary. The following directors were elected to serve a term of three years: A. J. Fausek, Modern Engineering Co., St. Louis, Mo.; Elmer Smith, Smith Welding Equipment Co., Minneapolis, Minn.; and Ellsworth Mills, The Bastian-Blessing Co., Chicago, Ill.

A. Bede Harrower, of The British Oxygen Co., Ltd., London, England, and Walter S. Topping, Chief Inspector, Bureau of Explosives, were both elected honorary members of the I. A. A.

Pressure-Piping Code Covers Welded Construction

A Code for Pressure Piping has been issued as an American Tentative Standard, and is available at $1.00 per copy from the sponsor body, The American Society of Mechanical Engineers, 29 West 39th St., New York, N. Y., or the American Standards Association, of the same address.

The maximum limiting temperature specified throughout this code is 750° F., except for oil piping systems, where higher temperatures are permitted. The code is not applicable to building steam or hot-water heating systems or district-heating distribution piping where in both instances the working pressure does not exceed 15 lb. per sq. in. gauge.

The six sections of the code are as follows: Power piping systems; gas and air piping systems; oil piping systems; district-heating piping systems; fabrication details; and materials, their specifications and identification. The section on fabrication deals with pipe hangers, supports, anchors, sway bracings, vibration dampers, pipe joints (both welded and other than welded), and expansion and flexibility properties for piping.

A discussion of some of the welding requirements of this code will be found in this issue, beginning on page 28.

Cutting Off the Steel Piling Even With the Base of the Bridge.

Movie Relates to Production and Uses of Nickel

The complete story of the production and use of the important industrial metal, nickel, is pictured interestingly in a new 2-reel silent educational motion-picture film recently prepared under the supervision of the United States Bureau of Mines, Department of the Interior, in cooperation with an industrial concern.

The story opens more than a half a mile below the earth's surface, where nickel ore is mined, loaded into cars, hauled to the bottom of the shaft, and crushed. Huge electric hoists bring the ore to the surface, where it is crushed again, passed over a picking belt, pulverized in rod mills, concentrated by flotation, and smelted in reverberatory furnaces and converters.

Scenes which follow show spectacular operations of drawing the slag and tapping a cupola furnace, as well as electrolytic refining and casting.

The latter part of the film portrays the increased importance of nickel alloys, chiefly those with iron, steel and copper. It shows the electric furnace in which the alloys are made, and also tapping the furnace, pouring into moulds, and forging ingots. Other scenes portray handling of ingots, preheating of blooms, annealing furnaces, rolling mills, a pickling plant, and other incidental manufacturing operations. The film ends with several spectacular scenes showing how nickel is utilized in industry, in sports, and in the home.

Copies of this film in 16-mm. or 35-mm. sizes are loaned for exhibition purposes, to schools, churches, clubs, civic and business organizations, and others, upon application to the Pittsburgh Experiment Station of the United States Bureau of Mines, Pittsburgh, Pa. No charge is made for the use of the film, but the exhibitor is asked to pay transportation charges.

Bridge Bases Repaired by Means of Welded Piling

Repairs which would have been impracticable by ordinary methods, were recently made to the bases of a bridge at Binghamton, N. Y., by arc welding.

These bases had been seriously weakened by recent floods. Repairs were made by driving steel sheet piling into the water, around the bases. The steel piling was of rolled section, with each pile dovetailing with its neighbor at both edges.

As the clearance between the surface of the water and the bridge floor was considerably less than the length of piling required, it was necessary to drive the piling in sections. As each section was driven to the water's edge, an additional section was welded on, and driving continued. The welding was done with shielded-arc equipment supplied by The Lincoln Electric Co., Cleveland, Ohio. After the wall of steel was in place, the piling was cut off even with the bases of the bridge.

The steel sheath thus provided will prevent damage to the bases from future floods.

Using Arc to Splice Sections of Steel Piling.

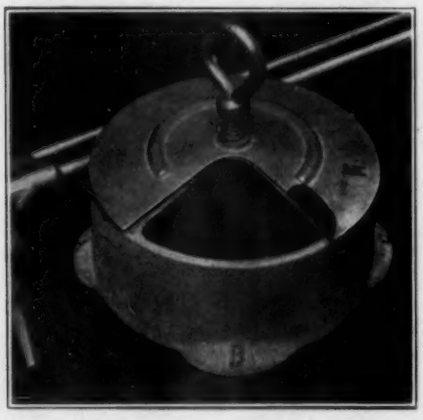
What's New in

Equipment and Accessories

Non-Spillable Container Has Four Flux Compartments

A rust-proof flux-container having four compartments and designed to prevent spillage, has been developed by the Schlafer Hardware Co., 501 N. Bates St., Appleton, Wis.

This new product consists of a cast-iron base and a two-piece cover. One of the cover pieces closes three of the compartments, and the second piece closes the fourth, and can be opened to



Four-Compartment Flux Container.

allow access to the flux. The cover can be turned until the open quadrant is over the flux that is to be used, thus sealing the other three compartments shut.

All parts are cadmium plated for protection against rust. The construction prevents spillage, and the flux remains clean and does not deteriorate due to exposure. This container is being marketed through jobbers.

New Rust-Proofing Process for Steel

Excellent rust-proofing at low cost is claimed by "cromodizing," a new process developed by the American Chemical Paint Co., Ambler, Pa. By preventing rust from forming beneath paint films, this treatment keeps steel units in serviceable condition. It is said to be adaptable to protecting any type of steel surface regardless of size, shape or previous processing. Prominent automobile manufacturers now using this treatment have shown in tests that the process will at least triple the life of the finish on steel parts, and they report that the paint has a better luster when applied over cromodized steel.

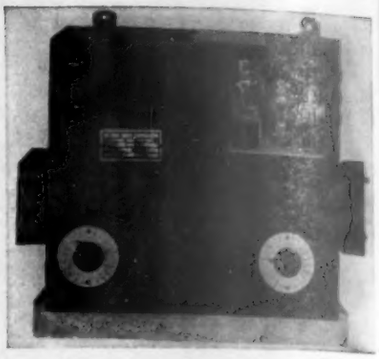
The process consists of dipping the steel product in a bath or spraying it with a solution of a proprietary chemical called "cromodine," for not more than one minute. Cromodizing is not a coating—it merely changes the surface of the steel, and hence is as flexible as the steel itself. Cromodized steel is also said to have the effect of oxidizing the lower part of the finish film, forming in effect a cement that firmly binds the paint to the metal.

High-Duty Oxygen Regulator Gives Close Regulation

A two-stage regulator, known as the Airco-DB Style 8490, designed for heavy cutting or deseaming jobs, furnace tapping and other operations where large volumes of oxygen are delivered at relatively high pressures, has been announced by the Air Reduction Sales Co., 60 East 42nd St., New York, N. Y. In addition to its high capacity, this regulator has the advantage of making available close pressure regulation with a low end-point. Even if the latter feature is not essential, it is recommended that this regulator be used whenever the oxygen demand per regulator exceeds 1,000 to 1,200 cu. ft. per hour.

The "feed-back" principle is used, marking a radical departure from conventional regulator design. Thus, the difference between the first- and second-stage pressures is always maintained substantially constant, with the difference being equal to the first-stage pressure when the adjusting screw is entirely released. This design results in the two stages keeping pace with each other and eliminates cumbersome weight and size.

High-Capacity Oxygen Regulator.



150-Ampere "Welco" Timer.

New Line of Timers for Spot Welding

A line of electro-mechanical timers for spot-welding machines has been announced by the Welding Timer Corp., 251 Ogden St., Newark, N. J. These timers each consist of an electronic timing element and a set of balanced contactors specially designed to handle the high overloads encountered in spot welding.

At one-cycle operation, a timing accuracy of ¼ cycle, plus or minus, is claimed. At slower speeds, for example, between 20 and 30 cycles, any reasonable accuracy can be assured, even up to 2% plus or minus. Timers for longer periods may be had on special order.

Standard settings cover a range of from 1 cycle minimum to 30 cycles maximum. Dial settings permit infinite variation of times between these extremes.

"Welco" timers are made in standard sizes for 30, 50, 150, 250 and 600 amperes, and larger sizes can be had on special order.

Welding Torch Equipped With Automatic Gas Shut-Off

A new welding torch, with thumb-lever-control "gasaver" shut-off in the handle, has recently been developed by the Weldit Acetylene Co., of Detroit, Mich. The object of this design is to save the greater portion of the 40 minutes of ordinarily wasted gases, when actual welding is not going on, out of every 60 minutes of flame time, which are the figures given by a time-study check. Thus cost of gases is reduced and production is speeded up. It is claimed that in one large Detroit plant, this torch has brought about an increased production of 116% over standard welding torches formerly used.

When the torch is in use, the operator simply puts his natural thumb pressure on the control lever in the handle, and lights and adjusts his flame for the work at hand in precisely the same manner as if he were using any ordinary welding torch. When the torch is turned away from the job, natural release of the thumb pressure on the control lever in-

"Weldit" Torch With Shut-Off Lever.

stantly reduces the welding flame to pilot-light size. When the torch again is directed on the work at hand, the thumb pressure on the control lever instantly produces the full pre-adjusted welding flame. This same pressure and release on the control lever may be repeated all day long without readjusting or relighting.

The length of hose in no way affects savings because the "gasaver" shut-off valve is located in the handle of the torch, less than one foot away from the working tip.

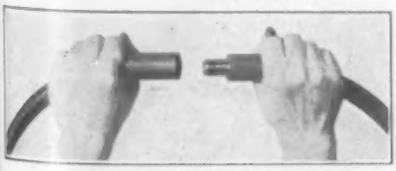
50-Lb. Acetylene Generator Has Underwriters' OK

A new 50-lb. medium-pressure acetylene generator for either portable or stationary service has just been announced by The Linde Air Products Co., 30 East 42nd St., New York, N. Y., and is known as the Oxweld Type MP-6 generator. It has a double rating of 100 cu. ft. of acetylene per hour, and has been tested and accepted by the Underwriter's Laboratories at the double rating, for both stationary and portable service.

The carbide feed is controlled by a handwheel, so acetylene at any pressure up to 14 lb. may be obtained. Pressed steel parts and bronze-welded galvanized steel sheet are used in the construction. There is practically no exposed piping, and the operating mechanisms and filter are assembled within the dome-shaped top of the generator. Special automatic controls add an element of safety.

Quick-Detachable Cable Connector

A new type of quick-detachable connector, designed for use in connecting welding or electrode cable, has been announced by The Lincoln Electric Co., Dept. CC-185, Cleveland, Ohio. To operate the connector, the plug is inserted in the jack and a twist of the wrist locks the connection. To disconnect, the procedure is reversed. Its operation is so simple that connection can be made in the dark. The connection cannot work loose nor be accidentally pulled apart. Protection against grounding is assured by fiber insulating sleeves.



Connector for Welding Cable.

Wide-Vision Goggle for Impact Hazard Work

An improved wide-vision chipping goggle has been announced by the Chicago Eye Shield Co., 2298 Warren Blvd., Chicago, Ill. This goggle is made for impact hazard work and is equipped with a new type of super-safety lens that does not change the direction of light rays. Other practical improvements in design insure a high degree of safety, wearing comfort and usefulness. The shape of the eye cups allows natural, full and wide vision. The goggles are close fitting, and the edges contacting the face have a pure-gum cushion binding. The large curved lenses are interchangeable by means of a simple hinged door. The curvatures are such that the lens is entirely free from focus, and the optical center is located so that the line of sight for an eye looking straight ahead through the lens suffers no deviation. These lenses are made from a high quality of crown glass, free from bubbles and striae, and are placed through a special hardening process which greatly toughens the glass, enabling the lenses to withstand severe blows and impact hazards.

Trade Literature

Heavy equipment of welded construction are illustrated and described in several leaflets recently published by Lukenweld, Inc., Coatesville, Pa. These cover a profiling machine with welded base, huge hydraulic press with welded frame, and drilling machine with lightweight welded base.

"The Repair of Damaged Cast Iron Machinery" is the title of a bulletin published by The Linde Air Products Co., 30 East 42nd St., New York, N. Y. Both fusion welding and bronze welding are described.

The design of welded girders for arc-welded tier buildings is discussed and calculations given in "Studies in Structural Arc Welding, Plate 52," issued by The Lincoln Electric Co., Cleveland, Ohio.

"Rego" welding equipment and accessories are listed and described in an attractive pocket-size catalog issued by The Bastian-Blessing Co., 248 E. Ontario St., Chicago, Ill. The company's new SX torch and new gas economizer are included.

Piping and tubing of various kinds and for different services are described in a pocket-size booklet issued by the advertising department of the Republic Steel Co., Massillon, Ohio. The booklet is entitled, "The Greatest Pipe Show on Earth."

A new catalog describing their complete line of welders' leather goods, including gloves, mitts, aprons, jackets, etc., is ready for distribution by the John Tillman Co., of 2716 American Ave., Long Beach, Calif.

Commercial News

The Going Was Tough But the Arc Welder Took It

Towed 10,000 miles over every kind of road imaginable, during which it covered all the Airco districts east of the Rockies except Minneapolis, negotiated mud so deep that the highest speed possible was only 6 to 8 miles an hour, exposed to rain, snow, sleet, dust storms and temperatures that varied from 86° to 4° below zero, the welding machine illustrated went through a three-months' jaunt, without one cent being spent for maintenance repairs, states Fred J. Maurer, director of the Airco Welding & Cutting Show.

Wilson Welder "On the March."

New Plant of Fort Wayne Welding & Supply Co.

The machine is a Wilson gas-engine-driven 300-ampere unit, mounted on a rubber tired truck-trailer. It was exhibited at 65 shows, at each of which from 50 to 150 men used the machine with all different types of Airco electrodes, and almost every man changed amperage and voltage in rapid succession. Naturally, the machine had to be in perfect condition, as one can't take chances when there are six or seven hundred people looking on.

New Process Plow Welding Holds Dealers' Meeting

The first annual dealers' meeting conducted by the New Process Plow Welding Co., of Perry, Iowa, was held on Nov. 5th, with over 100 dealers present. Though most of those attending were from Iowa, some were present from Indiana, Illinois, Minnesota and Nebraska. Eleven plowshare-reclaiming units were awarded as prizes.

The day's program included registration, demonstrations, and an outline of the dealers' set-up for 1936, in the morning. Following a lunch given for the dealers, a program was given devoted to a discussion of new cultivator shovels for 1936, and hard-surfacing alloys. Talks were given by John Kleen, of Pocohontas, Iowa; W. F. Lowder, of Humboldt, Iowa; and F. W. Swanson, of Creston, Iowa.

Two highlights of the meeting were a demonstration by Mr. Kleen of his portable metal-spray outfit, mounted on a new Ford V-8 chassis and complete in every detail, and the first Iowa showing of the new Tatroweld a.c. welder.

Fort Wayne Firm Celebrates Opening of New Building

The Wayne Welding & Supply Co., Inc., Fort Wayne, Ind., announces the formal opening of their new building on Nov. 22nd with a show which will include welding and cutting exhibits and demonstrations.

The new building is of modern shop construction, with special facilities for welding. The steel framework, as well as the piping and the furnace installation, is entirely arc welded. The building is heated with a Heggie-Simplex all-welded steel furnace with automatic stoker.

This new structure gives the company about five times the floor space of the old building, with increased storeroom and office space.

The following firms will demonstrate their products at the Nov. 22nd opening: Air Reduction Sales Co., Aladdin Rod & Manufacturing Co., The American Brass Co., The Bastian-Blessing Co., Metallizing Co. of America, C. E. Phillips & Co., Sellstrom Manufacturing Co., Sight Feed Generator Co., Will-Weld Manufacturing Co., and Wilson Welder & Metals Co.

Preparations are being made to hold monthly welding clinics in the new building and to conduct student classes in welding.

Airco Gives Show on Pacific Coast

Under the auspices of the Air Reduction Sales Co., and with the cooperation of the Oregon Institute of Technology, a most highly successful show and demonstration of cutting and welding was given at the Institute during the week of Oct. 14th. Both the oxyacetylene and electric processes were demonstrated for the students.

The show was serviced by the Airco Chicago exposition truck, and all operations, including piercing steel billets with the oxygen lance, cutting irregular shapes from steel plates, bevel cutting and Airco-welding of steel pipe, metal spraying, arc welding and other processes, were fully demonstrated, and explained through the help of an amplifier, to a large crowd of students and others in attendance.

The show was also repeated at the shops of Wentworth & Irwin, truck and motor vehicle builders of Portland.

The Lincoln Electric Co., Cleveland, Ohio, has announced the opening of new offices at Peoria, Ill., and Memphis, Tenn. The Peoria office is at 923 S. Washington St. and is under the direction of W. I. Miskoe, formerly of the Chicago sales force. It is a part of the Chicago district, of which G. E. Tenney is manager. The Memphis, Tenn., office is under the direction of O. B. Farrell. New personnel among the sales force includes Lew Hinchman, brilliant Ohio State football player of a few years back, who has joined the Chicago sales force; Paul M. Corp, a newcomer to the Milwaukee sales force; and E. H. Weil, who has been added to the San Francisco sales personnel.

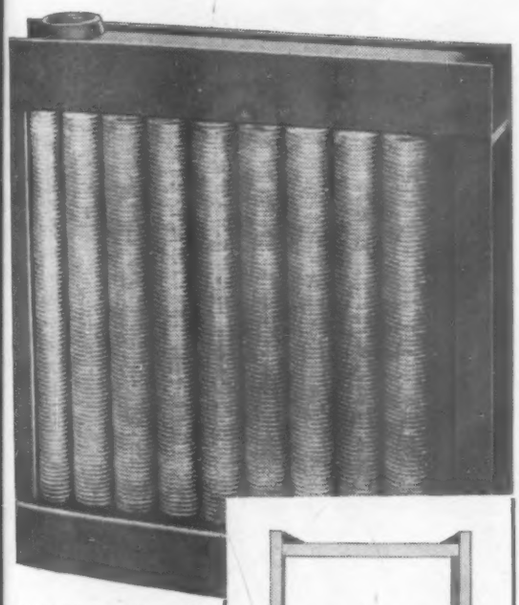
W. H. Gibb has resigned as vice-president of the Thomson-Gibb Electric Welding Co., of Lynn, Mass., and Bay City, Mich., and has incorporated the firm of Gibb-Lewis Co., 1331 Continental Illinois Bank Building, 231 S. La Salle St., Chicago, for the purpose of dealing in patents and patented articles. The new firm numbers among its clients a number of the large manufacturing institutions of the country, whom the firm puts in touch with new developments in their respective industries. Mr. Gibb continues on the Board of Directors of the Thomson-Gibb company, though he has withdrawn from active interest.

The Paramount Welding Supply Co., 5950 Second Blvd., Detroit, Mich., has been organized by C. L. Perkins and Pat. E. O'Connor. This firm has been appointed direct factory representatives for the S. M. S. Corp., C. H. Dockson Co. and the Frontier Bronze Co., of Niagara Falls. Mr. O'Connor was formerly a regional manager of General Motors, and Mr. Perkins was formerly with P. W. Fassler & Co., consulting engineers, of Detroit, after having served as welding supervisor for the Ford Motor Co.

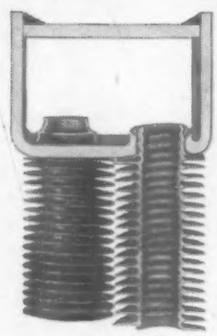
The Metal Spray Co., 113 Llewellyn St., Los Angeles, Calif., who have been manufacturers and distributors of metal-spraying guns and equipment for the past five years, have been succeeded by the Metalspray Co., Inc., of the same address. J. C. Martin, Jr., is president of the new firm, and H. B. Rice is vice-president and secretary. Mr. Rice was identified with the former company, and Mr. Martin is a consulting engineer and patent counsellor for several major industries.

Tobin Bronze Welding

Again provides a quick, sure and most economical method of assembly



UNIFIN Heater, manufactured by the Canada Vulcanizer and Equipment Co., Limited, of London, Ont. Copper tubes and steel structional members are Tobin Bronze Welded.



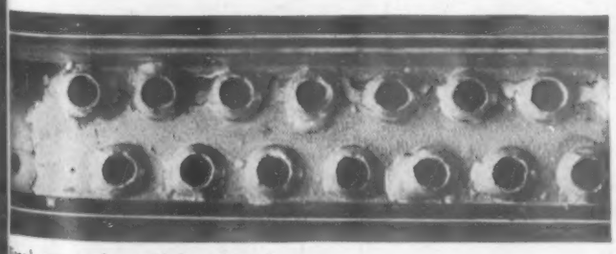
Cross section of the Tobin Bronze Welded "UNIFIN" Heater.

THE Canada Vulcanizer and Equipment Co., Limited, of London, Ont., manufactures unit heater elements and blast heaters. In the construction of the Unifin Heater, the one-piece "All-In-One" finned copper tubes are welded into the steel channel header with Tobin Bronze*. The steel top plate, enclosing the header, is likewise welded with Tobin Bronze. Welds are made quickly, and the resulting joints are strong, leak-proof, and uniformly dependable.

Tobin Bronze, with its high tensile strength, toughness, durability and uniform composition, frequently proves the quickest, surest, and most economical method of assembly. This time-tried welding rod is widely accepted as the ideal material for the production and repair welding of cast and malleable iron, steel and copper parts and equipment. Its low melting point of 1625°F. saves preheating, time and gas, and reduces the possibility of warping or cracking the parts. Be sure the bronze rod used for acetylene welding in your shop has the word "Tobin" stamped in the metal.

Tobin Bronze and sixteen other Anaconda Welding Rods are described in detail in Anaconda Publication B-13. This *new* 24-page booklet will be mailed to you free on request. Included also in this publication are recommended procedures for high voltage carbon arc welding of copper and copper alloys. Be sure to write for your copy.

*Reg. U. S. Pat. Off.



Finned copper tubes welded to channel steel header with Tobin Bronze.

ANACONDA
from mine to consumer
35231

THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Connecticut
Offices and Agencies in Principal Cities
In Canada: ANACONDA AMERICAN BRASS LTD., New Toronto, Ont.

ANACONDA WELDING RODS

General sales for the Weldit Acetylene Co., of Detroit, Mich., have been the largest this fall since 1929, states O. L. Smith, vice-president and general manager. Sales are continuing strong for their automatic flame cutters, two of which were recently sold in one day to two shops in Galion, Ohio, and for their new welding torch with automatic flame-cut-off feature, which is now being used by several of the larger automotive body plants.

The Kirkby Machinery & Supply Co., Toledo, Ohio, distributors of "Rego" welding and cutting equipment, announce that Richard Langdon has joined their organization and has been placed in charge of their welding department. Mr. Langdon, who is a graduate of the U. S. Naval Academy at Annapolis, Md., was formerly in charge of the arc-welding and underwater-cutting exhibit at the Museum of Science and Industry, in Chicago.

"Rego" welding and cutting equipment and other Bastian-Blessing equipment will be displayed starting Jan. 1st in a showroom at the corner of 19th St. and 6th Ave., New York City, where The Bastian-Blessing Co. has signed a lease for 20,000 sq. ft. of floor space. The company also has let a contract for a 30,000-sq. ft. addition to its plant at Grand Haven, Mich., at a cost of approximately $45,000.

William Carlton Read, for 25 years associated in an official capacity with metallurgical research and development activities of units of Union Carbide & Carbon Corp., died suddenly Nov. 6th at his home in New Rochelle, N. Y., at the age of 47 years. Mr. Read was intimately connected with many of the major research developments in the production and utilization of ferro-alloys and alloying metals.

The industrial exhibit promoted by the Milwaukee Association of Purchasing Agents, held at the Schroeder Hotel, in Milwaukee, on Oct. 22nd and 23rd, was attended by a capacity house. Made up of 129 exhibitors, it utilized the entire 4th and 5th floors and part of the 6th. Many of the exhibits were of direct interest to the welding industry.

George E. Clifford has been appointed district sales manager of Republic Steel Corp. in the Los Angeles, Calif., district, following the resignation of George F. Emanuels. Since August, 1930, Mr. Clifford had been assistant manager of sales in the Pipe Division of the Republic corporation.

The Torchweld Equipment Co., Chicago, Ill., announce the appointment of the Dartt Welding Equipment & Lock Co., 112 East 13th St., Kansas City, Mo., as distributors. The Kansas City firm will stock the complete line of Torchweld equipment and repair parts.

The Eastman Manufacturing Co., Manitowoc, Wis., manufacturers of high-pressure hose connections, announce the changing of their oxygen and acetylene hose connections to conform to the recommended standards of the International Acetylene Association.

The Machinery & Welder Corp. announce the appointment of H. C. Close and S. E. Borg to the sales staff of their Chicago office. Both of these representatives have a well-rounded background of technical and practical experience in the field of welding.

H. W. Roth, president of the Roth Engineering Co., Inc., 1165 Harper Ave., Detroit, Mich., recently returned from a European trip, during which he studied welding in relation to various industries, particularly the automotive industry.

The Welder Service Co., 3620 Detroit Ave., Toledo, Ohio, have been appointed by the Torchweld Equipment Co., Chicago, as distributors of their equipment, with Mr. Homrighaus in charge of sales.

Notes From the Field

Shop Owner Visions Future for Newcomers in Field

Starting business in Battle Creek, Mich., exactly ten years ago, in a 16x20-ft. shop, Dillon's Welding Shop has increased its space until now it occupies 40x80 ft., and at present the shop is being remodeled to make room for additional equipment. "If business in the next 10 years is as good as it has been in the past, I surely won't be sorry I picked Battle Creek to start a shop in back in 1925," says Mr. A. F. Dillon.

Looking into the future, Mr. Dillon expresses the belief that welding is going to become more fascinating, more enjoyable to work at, and more profitable to those engaged in it than it has been in the past. Credit for this improvement belongs in part to developments in apparatus, welding rods, and technique.

"Inasmuch as we have dispensed with the fence wire and old piston rings as welding rods, our electrodes do not fly all over the room when we are welding, and we no longer have to preheat our castings with logs and scrap wood, we poor welders do not have so much to worry about.

"I do hope," continued Mr. Dillon, "that the young fellow starting in welding now won't get the idea that this industry has about reached the height of application, as so many thought 20 years ago. I believe that the newcomer has just as much ahead of him in the advancement of the process as there was ahead of me 24 years ago, when I started work as a welder."

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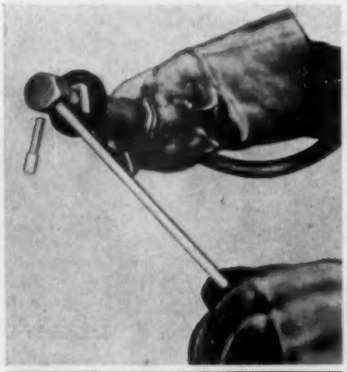

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NAVY YARD

The largest steel tank ever built by the Heine Boiler Co., St. Louis concern, during its 52 years of experience, was recently completed for the Shell Petroleum Corp. refinery at Houston, Texas. This tank, known as a bubble tower, is 65 ft. long, 11 ft. in diameter and weighs 200,000 lb. A special derrick was made for moving the tank to two freight cars. Two car loads of pipe outlets accompanied the tank. Two smaller tanks are now under construction at the boiler works. One will be 40 ft. long and 11 ft. in diameter, and the other will be 20 ft. long and 6½ ft. in diameter. These are part of the bubble-tower equipment. Approximately 50 men worked three months to build the large tower.

The Welded Fabrication Co., recently organized by the joint partners, R. T. Quick and J. Q. Davis, has opened for business at 6009 Wilmington Ave., in Los Angeles, Calif. The new plant is being equipped to weld-fabricate machinery and steel products, and includes forming, hot and cold heavy hydraulic press work, mechanical flame cutting and sand blasting. The concern also maintains a portable welding and mechanical flame-cutting service for field jobs. Mr. Quick, general manager, was formerly chief engineer of Universal Motors, Inc., and Mr. Davis, plant superintendent, formerly operated a job welding shop in Bell, Calif., under the name of Jayco Welding Company.

The American Barge Line Co., of Louisville, Ky., has placed an order with the McClintic-Marshall Corp., of Pittsburgh, Pa., for the construction of a fleet of 8 steel barges, each equipped with 6 all-welded tanks for the transportation of petroleum products. The barges will each be 175 ft. long, 35 ft. wide and 11 ft. deep, and delivery will be made from the Leetsdale works of the company during January and February, 1936. These 48 tanks, one of the largest orders placed in recent months, call for a total of 2,600 tons of steel, and the entire order involves an outlay of approximately $200,000.

Sparks from the electrode of a welder caused a $100,000 fire in Los Angeles, Calif., recently. Electrical welding was being employed in the repairing of the Norton Building, at 6th St. and Broadway. The molten sparks set fire to scaffolding and quickly spread to inflammable material in the building below. First reports were that an acetylene tank had exploded, starting the blaze, but this was proved false by fire inspectors. The explosion which ensued was caused by burning alcohol and chemicals. Debris was hurled into the street and windows broken in shops across Sixth St.

Three Peoria companies have been awarded government contracts, totaling $73,271.91, according to information from Washington, D. C. These companies and the amount of their contracts are: Caterpillar Tractor Co., $33,309.07; R. G. LeTourneu, Inc., $30,710.84, for 9 scrapers; and the Peoria branch of the Pittsburgh Steel Co., $9,252, for welded wire fabric. The first two contracts cover equipment for use in CCC work, and the last for Army use at New Orleans. All contracts involve considerable welding.

There is quite a demand in the Pittsburgh market for welded stainless steel annealing boxes for use in electric furnaces, according to information received by *The Welding Engineer*. Rasner and Dinger, North Ave., Pittsburgh, Pa., are building a large quantity of these boxes for the Universal Steel Co. for installation at their Bridgeville, Pa., works. The American Rolling Mill Co., Butler, Pa., are also building two hundred of these boxes for use in their own furnaces.

The American Pipe & Steel Corp., of Los Angeles, Calif., recently completed the construction of an all-welded 25,000-barrel gasoline storage tank for the Mohawk Oil Co. at the company's Fruitvale refinery. This is the first welded tank of this large size ever built in the California fields. Five gas-engine-driven electric welders were used in the work of welding the tank, and shielded-arc electrodes were used throughout. Lap joints were employed in the construction.

The McClintic-Marshall Corp., of Pittsburgh Pa., Bethlehem Steel subsidiary, recently obtained an order for 46 welded brewery storage tanks for the Pittsburgh Brewing Co. These tanks, which are 7 ft. 7 in. in diameter and of various lengths, have a total capacity of 7,000 barrels, and will require 150 tons of steel at a cost of approximately $22,000. The tanks are for immediate delivery and are to be fabricated at the Leetsdale works.

W. A. Hooper, formerly associated with the Acme Welding Works, of Long Beach, Calif., has started an oil-field welding service under his own name in the Signal Hill oil field. Mr. Hooper has an attractive and complete portable electric and acetylene outfit mounted on a new Ford V-8 truck. The equipment includes a portable acetylene generator, somewhat of a new feature in that district. Headquarters are at 520 Burdett St., Long Beach.

In its 34 years of continuous service, the Crego Gear & Machine Works, Inc., 1416 Walnut St., Kansas City, Mo., has seen the city grow from a small trading

The Right Rod for Each Particular Purpose

23 Kinds—In Stock

Ryerson Engineers have developed a series of rods that we know are outstanding for quality production. They are continually working—checking, testing and improving—to develop rods that will do specific types of work, faster and better.

Bring your welding rod problem to Ryerson—you can be sure of finding the right rod for each particular class of work—one that embodies the latest and best in welding practice.

We would like to have you test any of the Ryerson rods in your shop—and let their performance tell the story. We will be glad to furnish samples. Address the nearest plant.

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Write for Bulletin 56

RYERSON STEEL-SERVICE

center to a metropolis of over half a million people. With one possible exception, this shop is the oldest welding firm in Kansas City. E. C. Crego, president, says there has been a heavy demand lately for servicing and repairing of second-hand machines and equipment.

The heads of all Kansas City welding shops should form a local organization, in the opinion of M. E. Dollison, president and general manager of the Dollison Welding Shop, 512 East 18th St., Kansas City, Mo. "It is true that in this age of keen competition it is hard to eliminate price cutting," he says, "but the getting together of members of the trade to discuss these evils should be productive of good results."

A catalog is being prepared by the Custombilt Mfg. Co., of 1505 S. Santa Fe Ave., Los Angeles, Calif., featuring a line of ten different models of all-welded truck bodies, trailers and semi-trailers. In the descriptions, particular attention is called to the all-welded construction with emphasis and engineering proof of the superiority of welded over other types of construction.

Some extensive contracts in the welding of steel frames have been completed during recent months by Camp & Luthy Welders, Inc., 1924 Baltimore Ave., Kansas City, Mo. Sizable contracts involved work for the Kansas City General Hospital, Liquid Carbonic Co., Montgomery Ward & Co., and the new plant of the Getz Brewing Co., at 17th and Indiana Aves.

Sheet-metal shops in the Pittsburgh district are finding a new application for welding in air-conditioning problems, particularly in the use of the lighter-gage steels. The Robinson Ventilating Co., Zelienople, Pa., have been doing quite a bit of welding recently in connection with the fabrication of ventilating and air-conditioning equipment.

Plans are being made for a 22-mile 10-in. welded gas pipeline to be constructed by oil operators of the Mountain View (Calif.) oil field. The proposed line would be a gathering line for gas now wasting into the air from the various oil wells, and would connect with the main trunk line of the Southern Fuel Co., near Grapevine.

Prow & Leffler, welding specialists, featuring pipeline, tank and boiler work, recently remodeled and enlarged the office of their plant in El Monte, Calif. Twenty feet has been added, affording a front entrance and added space for a stock room. The concern reports a good current business in welded irrigation pipeline work.

A large welding project by the Sinclair Refining Co., in Smith and Rusk Counties, Texas, will soon be under way, involving the early construction of a natural-gasoline extracting plant at Wright City, and a 200-mile system of welded gas-gathering lines. The plant will have a daily capacity of 50,000 gallons.

A large contract for welding the steel framework for a new penitentiary building at Springfield Mo., has just been completed by Brown's Midwest Electric Arc Welding Co., 1743 Walnut St., Kansas City, Mo., according to C. C. Brown, manager of the firm's welding department.

The American Body & Welding Co., 919 East 15th St., Kansas City, Mo., specializing in steel-metal tanks, has a large, continuous contract to take care of the service for a large steel-tank concern. The firm recently purchased a new 300-ampere arc-welding machine.

Frank McKnelly, formerly owner of the M & M Welding Service at Waukegan, Ill., has organized the Commercial Welding Service, 830 S. Center St., Stockton, Calif., engaged in both arc and oxyacetylene welding. He is considering adding a blacksmith shop.

The Aetna Oil Service Co., Louisville, Ky., are in the market for a welded pressure sphere, 41 ft. in diameter. The sphere is to be made of ¼-in. plates and will have a capacity of 6,000 barrels. It is for gasoline storage and will be located at the Louisville refinery.

Charles E. Murry reports that the S. G. Murry Welding Co., 813 First Ave., Altoona, Pa., has been kept busy with the welding of truck chassis for the City of Altoona for the past few months. The company is also doing considerable out-of-town work.

A fleet of eight tanks, taken from railway trucks, welded in pairs, and placed in the water as a medium for river transportation, is now being towed from Chicago to Kansas City, where they will be loaded with fuel oil for movement back to Chicago.

Bids for three 45-ft. all-welded steel survey single-screw boats are being received by the United States army engineers of the Louisville, Ky., district. Only welded equipment will be considered. The award is expected to be announced shortly.

The Moffett Motor & Welding Service, 1009 North 9th St., Kansas City, Kan., has been increasing its working force and has recently added a new arc-welding machine. New machinery is being installed to keep pace with their business needs.

The Southwest Welding & Mfg. Co. recently installed new automatic electric shielded-arc welding equipment in its plant at Alhambra, Calif., and has been for some time on production on large-diameter pipe for a Los Angeles municipal water main.

D. J. Cody, owner of the Cody Boiler Works, 511 West 4th St., Kansas City, Mo., reports that his firm has just completed a large contract at Nebraska City, Nebr. This firm specializes in boiler work, and maintains a modern welding plant.

With cold weather approaching, the Welding Information Center, 741 West 70th St., Chicago, concluded their season's activities with the meeting of Nov. 5th. Present plans are that meetings start again in April.

Criswell Chevrolet Co., 1315 Thirteenth Ave., Altoona, Pa., has been given the contract for doing all the welding work required on trucks owned and operated by the Penn Cress Ice Cream Co., of that city.

"Hutch" Coleman, of 5211 Maywood Ave., Maywood, Calif., recently completed the assembly of a portable electric welding unit, and will handle general field and job welding in the future.

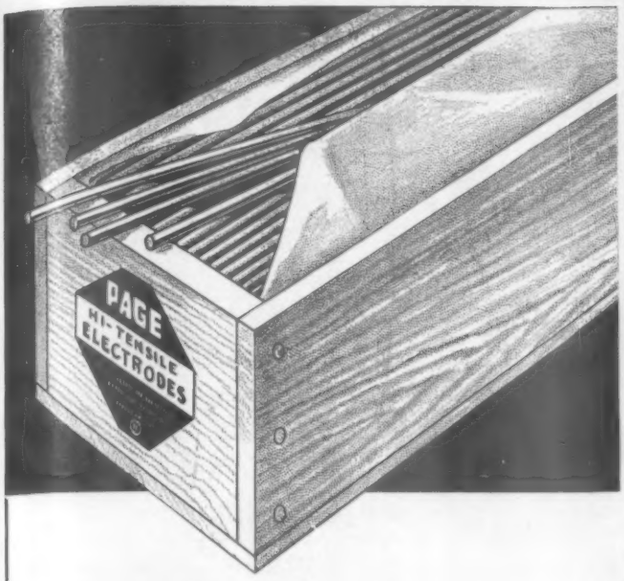
J. ("Spider") Davis, who until recently operated a welding shop at 3605 E. Gage, in Bell, Calif., has moved into new quarters and now is located at 6009 S. Wilmington Ave., in Los Angeles.

The Weld-Rite Welding & Machine Shop has been opened by Charles W. Dean, welder, and J. B. Sigler, machinist, in Ft. Myers, Fla., at Union and Hendry Sts.

The Weidner Welding & Engineering Co., Mattoon Road and Reynolds Ave., Kansas City, Kan., are engaged on a large conveyor job for the PWA at Beloit, Kan.

The Keystone Equipment Co., of Omaha, Nebr., is using electric welding in the manufacture of all-steel frames for the trailer bodies put out by that company.

The Nebraska Boiler Works, Lincoln, Nebr., is finding a small portable welder a real money-saver in the repairing of furnaces.



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They lower production costs because of their excellent arcing characteristics which permit operators to produce smooth, uniform welds at high speed . . .

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In addition to Page Hi-Tensile "Shielded Arc" Electrodes, Page also make High Tensile Flatweld Electrodes which are excellent for high speed production in the flat position only.

Both of these electrodes are fully described in literature which will be sent you upon request.

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Adams offers a complete line of arc welding equipment for all purposes—Vertical Motor-Driven Arc Welders, Engine-Driven Arc Welders with remote control, Automatic Welding Heads, Automatic Welding Wire, Mineral-Shielded Electrodes, Self-Annealing Electrodes, Alloy Electrodes (various types) and a complete line of welding accessories. Write for complete information.

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Welding Division—Indianapolis, Indiana

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Bargains—Una 400-ampere Welder, stationary type; Hansen 600-ampere welder, generator only; Wilson 300-ampere portable welder; rebuilt Metallizing spray gun with Underwriters' seal. Welding Engineering Co., Milwaukee, Wis.

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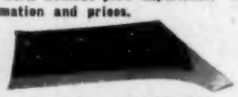

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For Sale—Well-equipped blacksmith and welding shop. County seat. Population 5,000. Good farming country. For particulars write E. S. London, De Ridder, Louisiana.

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To organize and direct the marketing of arc-welding electrodes and equipment for nationally known company. Sales engineer, preferably college graduate, not over 42, with extensive selling experience and thorough practical knowledge. Applications will be held in strict confidence. Address N-4, The Welding Engineer.

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Divisional Vice-President, American Welding Society
Vice-President, The Lincoln Electric Co.

This is a book of some 450 pages, nicely bound and containing 19 of the prize winning papers entered in the Second Lincoln Arc Welding Prize Competition. Due to their length it was necessary to brief some of the papers, but it is a book that should be read by everyone interested in welding. It contains 5 parts on the following subjects: Machinery—Ships—Buildings, Bridges, Houses—Large Containers—Piping and Fittings.

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